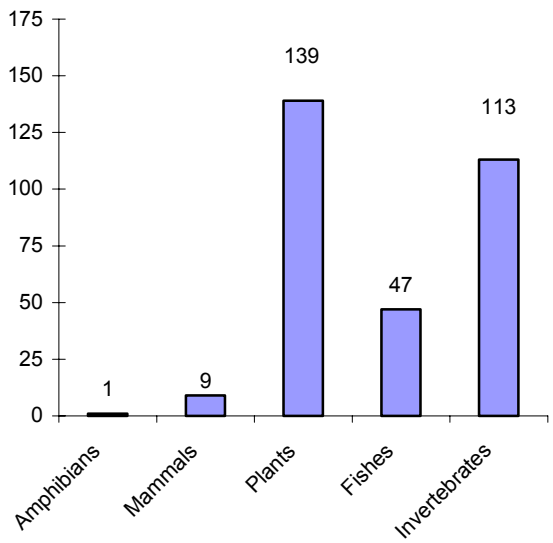
Biological Resources

Flying over Nevada's numerous mountain ranges or speeding across shrub-covered basins on the Loneliest Road in America (Highway 50), travelers will undoubtedly miss one of the state's most notable features - the enormous variety of wildlife and habitats that grace the state. The corrugated topography and dramatic elevation changes gives rise to many distinctive climate and vegetation zones, from salt desert scrub surrounding dry lakebeds (playas) to alpine tundra with persistent snowfields. In between, lies a rich diversity of shrub, woodland, forest, grassland, and riparian zones. Botanists have found over 2800 different native plants in Nevada, 139 of which occur nowhere else. Though predominantly arid to semi-arid, the moister, higher elevation climate zones capture sufficient amounts of snow and rain to feed numerous rivers, creeks, lakes, wetlands, and springs. Many unique native fishes, freshwater snails, birds, amphibians, and insects inhabit these widely distributed aquatic resources. Overall, Nevada hosts well over 3800 plant and animal species and some of the most biologically diverse ecoregions in North America.

Biodiversity and Ecoregions

Nevada is inhabited by a large number species and subspecies (i.e., taxa) that are unique to Nevada (i.e., endemic). With 309 kinds of plants and animals found in the state and nowhere else, Nevada ranks sixth in the nation for the number of endemic animal and plant species (Figure 3-1). As scientists continue to study the state's biological resources, the number of taxa will change. In particular, the number of endemic aquatic and terrestrial invertebrates is certain to increase.

Figure 3-1. Endemic Taxa of Nevada



Source: Nevada Natural Heritage Program, 2001.

Why does a predominantly arid state harbor so much biodiversity? Basically, the complex history of regional climate swings that occurred over recent millennia propelled a series of changes in the distribution and abundance of water and vegetation, as well as landform features. As new and diverse habitat conditions formed, animals and plants were migrating, adapting, and evolving in order to survive. An important condition for species evolution is isolation. The basin and range topography, fluctuations in large ancient lakes, and vegetation zones shifting with climate changes resulted in populations of terrestrial and aquatic species becoming separated and isolated.

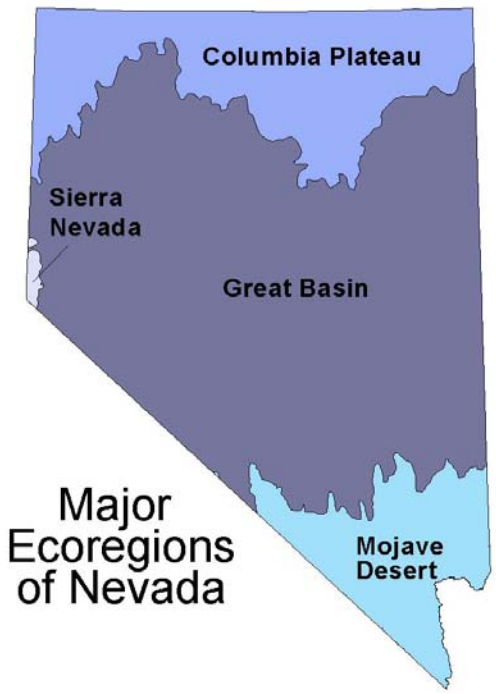
With 314 named mountain ranges and 232 (hydrographic) basins, the basin and range topography is the state's most prominent feature. Mountain ranges are mostly tilted fault-bounded blocks, five to 15 miles wide, with many extending more than 50 miles. Peaks and ridges typically rise 1,000 to 5,000 feet above the floors of the intervening basins, and occupy roughly 40 to 50 percent of the total land area. The basins are filled with rock and soil eroded over millions of years. Very coarse to fine grained sedimentary layers make up the valley fill deposits, which range in thickness from several hundred feet to more than 2 miles (Fiero, 1986). Elevations of larger valley bottoms vary from 500 feet above mean sea level to 6,800 feet. Twenty-five mountain ranges have at least one peak over 10,000 feet (Grayson, 1993). Nevada climbing enthusiasts report summiting 42 peaks higher than 11,000 feet (Strickland, 2002).

Periodically during the past 10,000 years, many northern Nevada basins were filled with freshwater lakes. The inundated valleys separated populations of the same species and created new habitat conditions. The largest prehistoric lake within the state was Lake Lahontan, which at its peak inundated about 8,600 square miles in the Humboldt, Truckee, Black Rock, Carson, and Walker basins. Remnant features of the wetter, cooler periods, the last of which ended 4,000 years ago, are found in desert "sinks" distributed throughout northern Nevada (Grayson, 1993). Relict landform features include terminal lakes, playas, and wetland complexes ringed by ancient wave cut terraces. Pyramid and Walker lakes are the lone survivors of ancient Lake Lahontan. These rare relict lakes are fed by snowmelt from the Sierra Nevada Range, which ironically captures so much moisture from Pacific storms that an enormous rain shadow is cast across the state.

The relatively recent and rapid climate transition from wetter and cooler conditions to drier and warmer brought about region-wide changes in the distribution and abundance of plant species and community types. Conifer forests withdrew into the mountains, replaced by pinyon and juniper woodlands and expanding shrubs and grasses. As water bodies receded and groundwater recharge declined, wetlands and riparian zones contracted. Ultimately, the climate changes and the highly segmented landscape provided new, unique, and isolated habitats in which aquatic and terrestrial species adapted and evolved. Thus, the ecosystems in which we live are the recent product of a dynamic period in the state's natural history. Nevada consists of four major ecosystem units, or ecoregions - the Great Basin, Mojave Desert, Columbia Plateau, and Sierra Nevada (Figure 3-2). Most of the state's population resides in the Great Basin and Mojave Desert ecoregions.

The Great Basin covers about 48 million acres (68% of the state). Roughly two-thirds of the ecoregion falls within Nevada's borders, with the remainder in Utah and California. Of 110 ecoregions in North America, the Great Basin ranks fifth in total species richness and second in diversity of imperiled species (The Nature Conservancy, 2000). Valley bottoms in the Great Basin sit at higher elevations and more northerly latitudes than the Mojave Desert; thus, the climate is cooler, moister, and vegetation grows thicker. Salt tolerant shrubs and playas prevail in the lower valleys. Expanses of sagebrush and other shrub communities cover most of the higher valleys and slopes, occasionally mixed with grasses, especially at higher elevations. Pinyon and juniper, or pygmy conifer, woodlands occupy large portions of lower elevation mountain slopes and ranges. Conifer and hardwood forest occur in widely dispersed patches. Major rivers are limited to the northern and western extremities. Numerous perennial and ephemeral creeks drain higher elevation ranges. Thousands of springs dot valleys throughout the Great Basin. Almost all precipitation falls during winter, with temperatures cold enough to bring more snow than rain. Warm springs and hot summers hasten snowmelt from the mountains and quickly evaporate the moisture in upland soils. Gradually, stream flow dwindles to a low flow or dry state by late summer.

Figure 3-2. Major Ecoregions of Nevada



Source: Nevada Natural Heritage Program, 2001.

The Mojave Desert covers the state's southern tip, and extends into California, Utah, and Arizona. Compared to the Great Basin, Mojavean valleys are broader and mountain ranges fewer. Vegetation is widely spaced on the hot, dry valley floors and slopes. Cacti and

Mojave yucca are abundant at lower elevations, cohabitating with white bursage. Higher desert vegetation zones are identified by blackbrush, creosote bush, and shadscale. Joshua trees and perennial grasses occur in higher shrub-dominated valleys. Mid-level mountain elevations support pinyon and juniper in several ranges. Forested mountain areas of pine and fir have a limited, high elevation distribution (Utah State University, 1996). On average, less than five inches of rain falls in the winter and during the summer monsoon season, but higher elevations often receive several feet of snow. Extensive water bearing carbonate rock formations contribute flow to some perennial stream reaches and numerous springs, a number of which are inhabited by rare fishes and snails. The Colorado River flows through the eastern portion of the ecoregion. Other important streams are the Amargosa, Muddy, Virgin, Meadow Valley, and White rivers. Desert tortoise, Amargosa toad, Mojave yucca, and Joshua trees are distinctive life forms in this ecoregion. Over 1.4 million people inhabit Las Vegas Valley, which lies centrally in the Nevada portion of the Mojave Ecoregion. Urban development, outdoor recreation, military uses, and large reservoirs are major land uses.

The southern portion of the Columbia Plateau ecoregion stretches across northern Nevada, and extends into Idaho, Oregon, Washington. In Nevada, landforms are a mix of basin and range and volcanic plateau features, with inclusions of low lying alkaline lakebeds in the westernmost portion. A variety of sagebrush and perennial grass, or sagebrush steppe, communities prevail as the dominant vegetation type. Salt desert scrub and pinyon woodlands are scarce in the cooler climate, which favors juniper woodlands and mountain mahogany. Rocky Mountain type subalpine conifer and aspen forest patches occur at higher elevations of the volcanic highlands and mountain ranges. Higher average annual precipitation sustains many small perennial streams that flow northward to tributaries of the Snake River in Idaho. The valleys are semi-arid, although irrigated pastures makes up a greater portion of the vegetative cover than elsewhere in Nevada. Livestock grazing, irrigated pasture, big game habitat management, and hunting and fishing are major land uses. Towns are small and remote, sustained by the agricultural- and outdoor recreation-based economy.

In contrast, fast growing cities and towns are clustered along the margin of the Sierra Nevada ecoregion. Moderately well forested, the steep granite slopes along the eastern edge of the Sierra Nevada Range is the source of numerous mountain streams. The Eastern Sierra and Carson Range watersheds feed Lake Tahoe and three major rivers that yield a substantial amount of water for farming, urban and industrial development, water-based recreation, and desert lakes and wetlands. Eastern Sierran mixed conifer forest and mountain shrub communities are accustomed to a milder climate pattern and thus have a limited presence eastward. Only small patches of Sierran plant communities occupy the most favorable locations in adjacent mountains of the Great Basin ecoregion. Commercial logging, ranching, and forest/range wildlife habitats are being replaced by urban and suburban development, outdoor recreation facilities and trails, and tourism along the eastern Sierra Front.

A few important generalizations can be made about the ecoregions in Nevada. Compared to the Columbia Plateau and Sierra Nevada ecoregions, natural plant communities of the Great Basin and Mojave Desert ecoregions appear to be less resilient and slower to recover from intensive land use and natural disturbance. Dispersal of noxious weeds and cheatgrass appears to be a more significant problem in the Great Basin and Columbia Plateau ecoregions than the others, although red brome continues to invade Mojavean shrub communities. A majority of the more than 2.3 million acres that burned during 1999 and 2000 were from wildfires located in the Great Basin ecoregion. The environmental and habitat impacts of urbanization are most evident in biologically diverse areas of the Sierra Nevada, western Great Basin, and Mojave Desert ecoregions. However, in all ecoregions, intensive agricultural, mining, past logging, and outdoor recreation land uses as well as uniform suppression of fires have, to varying degrees, contributed to widespread, significant ecological changes in rangeland, forest, aquatic, and riparian zones.

Wildlife and Habitat

Nevada is home to West-wide common species of wildlife and plants, such as mule deer and sagebrush, as well as endemic and rare species that have adapted to unique habitats, such as the Railroad Valley

springfish (*Crenichthys nevadae*) and Las Vegas bear poppy (*Arctomecon californica*). The Nevada Division of Wildlife (NDOW) and U.S. Fish and Wildlife Service (FWS) have primary responsibilities for protecting and managing wildlife according to various state and federal regulations and special management designations. Most of the wildlife habitat is managed by the BLM, USFS, and FWS, which combined control the use of land on about 80 percent of the state. The Nevada Division of Forestry also has certain vegetation protection and management responsibilities on state and private land for designated plant species.

Before state and federal agencies regulated hunting and fishing, populations of many native species plummeted due to lack of awareness and carelessness. Now that state and federal agencies oversee hunting and manage wildlife and habitats, better data are available on the numbers and distribution of game species. NDOW routinely gathers information from hunters and fishers, and with fees paid by hunters, conducts surveys and models population dynamics of game species. In addition, scientists have gained more knowledge about imperiled animal and plant species. However, these species constitute a small fraction of Nevada's total biodiversity. A frequently stated theme regarding our biological resources is the dearth of information on the vast majority of plants and animals that populate our ecosystems.

One way to report on the overall status of Nevada's wildlife and plants is to group species according to designations that indicate their management or conservation status (Table 3-1). For example, native and endemic species are classified and tracked to account for the state's overall and unique biodiversity. Game species are wildlife that are hunted, fished, or trapped by sportsmen. Federally threatened and endangered species are those whose numbers have dwindled and are believed to need special protection and recovery actions in accordance with the Endangered Species Act of 1973, as amended. Rare and sensitive species are identified during periodic review of the state's inventory of native species that takes into consideration the population size and distribution, level of threats and corresponding management attention, and the biology of the species.

Table 3-1. Number of Wildlife and Plant Taxa by Management Designation

Major Groups	Native	Endemic	Game	Extinct & Extirpated	Federal Threatened & Endangered	Rare and Sensitive
Mammals	128	9	16	6	0	53
Birds	283	0	50	2	6	47
Fishes	91	53	30	11	23	63
Reptiles	54	0	0	0	1	7
Invertebrates	unknown	113	0	6	2	171
Plants	2800	139	0	0	9	297
Amphibians	16	2	1	1	0	6
Nevada Total	>4600	309	97	26	40	644

Source: Nevada Natural Heritage Program, 2002. Internet site: http://www.state.nv.us/nvnhp/
Note. Only taxa that regularly occur within Nevada are included in the category counts. Data on native invertebrate species are too limited to estimate. Information on species is constantly updated as more data becomes available. The counts will certainly change as more is learned.

Each species that has become extinct or extirpated (i.e., no longer exists in part of its native range, i.e., Nevada) represents an unfortunate loss and a reminder that careful resource management and development is essential for maintaining Nevada's biological diversity. The number of mapped rare species per thousand square miles is greatest by far in the Sierra Nevada ecoregion (81), followed by the Mojave (16), Great Basin (6), and Columbia Plateau (5) (Nevada Natural Heritage Program, 2001a).

Adequate habitat availability and quality largely determine the abundance and distribution of all wildlife species. Over the short term, wildlife populations and distribution fluctuates with winter precipitation patterns that in turn dictate seasonal plant growth and habitat conditions. Successive drought years can

be particularly stressful. Generally, the larger and more mobile animal species have adapted to extremely variable conditions by moving among suitable habitats, thereby maintaining healthy, widely distributed populations. Wildlife species restricted to small, unique habitat patches or with limited mobility are more sensitive and vulnerable to human alteration of the environment. Some of the most immediate wildlife diversity concerns occur where loss of unique, specialized native habitats is imminent. Yet, even mobile species are vulnerable to the cumulative fragmentation and deterioration of natural habitats. The range-wide decline of sagebrush ecosystems and sage grouse population is an example. Another example is found in the Mojave Ecoregion, where unique pool-, spring-, and pupfish populations that occupy widely distributed springs have been federally listed as threatened and endangered.

The vast openness of our state can give the impression that much remains wild and untrammeled. The practical reality is that the cumulative effects of land use and resource management activities, historically and today, have altered the structure, function, integrity, and biodiversity of wide-ranging and small, unique ecosystems. Progress in managing and improving remnants of native aquatic and terrestrial habitats, must keep pace with rapid population and economic growth. Otherwise, the likelihood grows that more species will be designated for mandatory protection under federal and state laws. By the time listing of a species as threatened or endangered has occurred, substantial ecological and economic losses and regulatory costs already are incurred, which are likely to extend far into the future.

Interest in balancing the land and water needs of human activities with those of native ecosystems has grown with Nevada's population. State, federal, and local government, industry, and citizens are working on joint conservation plans intended to ensure that viable populations of vulnerable species will be sustained. Relatively new tools include multi-species habitat conservation plans, conservation agreements, and the acquisition of conservation easements, land, or water rights. Also, resource managers are re-examining approaches to the control of floods, fires, and other natural disturbances for the purpose of determining how ecological benefits of such phenomenon can be safely and economically obtained. Species benefiting from specific collaborative initiatives include the Desert tortoise and other sensitive Mojave Desert species, the Amargosa toad, Columbia spotted frog, Lahontan cutthroat trout, Virgin River spine dace, and Greater Sage Grouse. However, 644 animal and plant species currently are considered to be rare or sensitive. Keeping these populations at safe levels while demand for land and water development expands will depend upon greater investment in coordination and advance planning to sustain existing high quality habitats and restore suitable sites.

Plants

The foundation of healthy wildlife populations and habitats is a diverse mix of native plant communities. Nevada's floral diversity is enormous. Botanists estimate roughly that 2,800 native species live in the state, of which 139 are endemic. The great variability in vegetation provides many different habitat niches and promotes diversity of associated animal life found here. Many plants are annuals, only living above ground for a short period of time – a necessity where daytime temperatures can exceed one hundred degrees and annual evaporation exceeds four feet to eight feet north to south. Trees and shrubs have many physical adaptations to access and conserve water, such as enormous root structures, waxy leaves, and the ability to drop leaves and become dormant during extreme dry periods.

Vegetation occurs in broad patterns, or zones, that reflect physical and biological factors, including climate zone, geology, landform, soil type, and inter-relationships with other plants and animals. Vegetation zones consist of commonly associated species and are often classified by dominant plant species or position in the landscape. Since precipitation and temperature strongly influence the distribution and species composition of vegetation, the zones transition from south to north and from warm, dry valleys upslope to cooler, moister mountain canyons and ridges. In Nevada, vegetation zones are identified as alpine, montane, pygmy conifer, sagebrush, blackbrush, saltbush or shadscale, Lower Mojavean, and absolute desert. Sand dunes, riparian, and lakes and ponds are "azonal" features that occupy a relatively small area of each vegetation zone, but occur frequently. Within a zone, distinctive plant communities can be found, which are generally characterized as forest, woodland, meadows or grasslands, and shrublands (Charlet, 1998).

Because vegetation zones describe broad, landscape scale patterns of floral diversity, relatively rapid or distinctive changes in species composition, boundaries, continuity, or ecology of a vegetation zone should be seen as signals that significant natural or human stresses are at work and special management attention may be needed. The vegetation zones showing signs of extensive changes are the sagebrush, pinyon/juniper woodland, saltbush, and riparian zones. Contributing factors variously include excessive grazing by livestock, wild horses, and wildlife; expansions of non-native grass and weed species; suppression of wildfire in fire-maintained ecosystems; bigger and more frequent wildfires; a warming in certain climate zones; fertilization effect from higher atmospheric carbon levels; deteriorated watershed conditions; and, conversion of land for urban, agriculture, mining, and transportation developments. Two zones of special statewide concern are the riparian and sagebrush zones.

Historical loss and deterioration of riparian zones and wetlands is extensive. Occupying a small fraction of the landscape, riparian and wetlands contribute greatly to biodiversity, as well as the production of clean water. These areas produce large amounts of biomass that provide food and habitat for many forms of wildlife. Riparian zones are found in moist soil zones between open water and drier upland sites, and traverse all vegetation zones. Since water supplies are limited, the much wetter riparian areas have a greater concentration of birds, fishes, bats, insects, and plants. Riparian corridors are critical habitat for breeding, feeding, and migration, yet are also the most impacted by water diversions, grazing, and various other uses. According to one reconnaissance level study, more than half of the state's riparian and wetlands have been converted to other land cover types (Dahl, 1990).

The sagebrush is the state flower, but that is not why declining land coverage and quality of sagebrush habitats is of general concern. The sagebrush zone contains many subtly different plant communities covering an enormous portion of Nevada, about 30 million acres. Prior to settlement, native sagebrush communities commonly contained a mix of shrubs, grasses, and forbs. Since settlement, use of the Great Basin sagebrush zone for ranching, wild horses, and big game species has been emphasized. More recently, cheatgrass has invaded millions of acres, forming monocultures where fire recurred and occupying voids in the shrub understory where native grasses and forbs have been removed. In other parts of the sagebrush zone, the shrubs are overcrowded, which, coupled with flammable cheatgrass, creates extensive beds of fuel for wildfires. Wildfires of catastrophic proportions have become more frequent in altered sagebrush ecosystems. The decline in the state's sage grouse population is one of several landscape scale biological indicators that the functions and values of sagebrush ecosystems are serious and widespread. Comprehensive statewide assessments detailing the magnitude of loss and degradation of riparian and sagebrush zones in Nevada are generally lacking. Public discussion and decision-making about changes in the sagebrush zone would be better informed if more comprehensive scientific documentation concerning Nevada-specific circumstances was available. Detailed mapping and data analyses of the composition, ecological status, and threats to sagebrush and riparian plant communities is necessary to provide a modern

A Wyoming big sage / Sandberg's bluegrass community type in Eureka County is pictured. Sagebrush ecosystems have been altered slightly to severely throughout the state. Sparse occurrence of forbs and grasses between shrubs is indicative of the reduced plant diversity and cover found in intensively used sagebrush. Ecological changes can be subtle but substantial over time. Removal of understory cover reduces exposes soil to sun and erosion, invites nonnative weeds to invade, oversimplifies the food web, and alters the availability of usable forms of nutrients and energy. Photo by Eric Peterson, NNHP. 2002.

information base as part of the planning process to improve land use practices, management strategies, and rehabilitation and restoration techniques.

Fungi

For many people, the mention of "fungi' brings to mind mold in forgotten parts of the refrigerator, or mushrooms at the grocery. In fact, there are nearly 70,000 species of fungi known worldwide, and many thousands more as of yet unclassified. Fungi are very diverse and many are important. Consider the yeasts used to make bread or beer, *Penicillium chrysogenum* (the source of penicillin), the beautiful but deadly Amanita mushrooms, delicious wild morels that pop up in recently burned areas, and the ubiquitous lichens on trees, rocks, or even soil. While most people think of fungi as plants, they actually form their own kingdom separate from plants and animals. Surprisingly, fungi are more closely related to animals than to plants. However, fungi are far less studied than plants and animals, and this is especially true in Nevada.

No checklist of species exists yet for fungi in Nevada. However, the collection at the USDA's Systematic Botany and Mycology Laboratory in Maryland has nearly 1000 species of non-lichen fungi from Nevada, and there is a preliminary checklist of about 300 species of lichens. The total number of lichens extant in Nevada will likely double to about 600 before surveys are complete. Lichens are unusual fungi that host colonies of algae growing in close association. In this symbiotic relationship, the fungus receives energy stored by the algae through photosynthesis, and the algae reside in a more hospitable environment. While some lichens reveal the green color of the algae growing within them, most have strongly colored pigments, which shield the lichen from harmful UV radiation, much like a sun-screen lotion. Common colors include brown, white, yellow, and orange.

The slow growth of lichens on rocks in arid regions makes them useful to anthropologist for dating cultural events (e.g., the age of a petroglyph). Lichens perform many functions in ecosystems, including forage, nesting materials, and nutrient supply. Beard-like lichens in some of Nevada's conifer forests likely provide foods for squirrels and other mammals. Greater Sage Grouse have been observed eating lichens on rocks during Nevada's cold winters, probably to get liquid water when everything else is frozen. Perhaps the most important function of lichens in Nevada is the formation of biotic soil crusts. These crusts, which also include mosses and free-living algae, form a deeply textured cover over soil in the spaces between plants, primarily in non-forested arid lands. Many crust forming lichens convert atmospheric nitrogen to a nutrient form usable by plants, increasing the nutritional value of forage. Biotic soil crusts also reduce soil erosion and surface runoff by absorbing raindrop impact. Although more research is needed, preliminary data suggest that crusts can inhibit cheatgrass germination.

Crusts are very sensitive to ground disturbances. Intensive livestock grazing nearly eliminated biotic soil crusts from much of the western landscape. Where crusts remain, decades old off road vehicles tracks can be seen. Native grazers undoubtedly impact the continuity of crusts, but their numbers and population densities are much smaller. Crusts are also killed by severe wildfires, though apparently they can survive light fires. In the driest areas of the Mojave Desert, biotic soil crusts may require several centuries to re-occupy disturbed sites. Fortunately, in moister sagebrush habitats, crusts should begin to recover within a couple decades and form reasonably well developed communities after a few more decades.

Mammals

There are 128 native mammal species and subspecies recorded in the state. Sixteen are game mammals, and therefore subject to hunting regulations set by the State Board of Wildlife Commissioners and enforced by the NDOW. Nine mammal taxa are endemic to Nevada. Fifty-three are considered rare or sensitive. Nevada mammals are very diverse. Among them are tiny shrews and jumping mice, large elk, secretive nocturnal bats, not so reclusive black bears, snowshoe hare, and the fastest land animal in North America, the pronghorn antelope.

Large native mammal species compete with introduced mammals (e.g., livestock and wild horses). Estimated numbers of large native mammals, livestock, and wild horses populating Nevada's wildlands are presented in Table 3-2.

Table 3-2. Estimated Number of Large Native Mammals, Wild Horses and Burros, and Livestock in Nevada, 1999 and 1990.

Animal Group	1999	1990
Large Native Mammals	173,350	204,900
Mule deer	145,000	180,000
Pronghorn Antelope	16,000	18,500
Bighorn sheep	6,650	4,000
Elk	5,700	2,400
Wild Horses and Burros	25,100	29,455
Livestock	595,000	631,000
Cattle and Calves	510,000	530,000
Sheep and Lambs	85,000	101,000
Total	793,450	865,355

Sources: Nevada Division of Wildlife, Nevada Department of Agriculture, and Nevada Bureau of Land Management

Large mammals greatly add to the wild appeal of open space, perform important ecological functions, and provide recreation for wildlife enthusiasts. The desert bighorn sheep is Nevada's state animal and exemplifies historic population trends of many wildlife species. Desert bighorn were formerly found in most mountain ranges south of the Humboldt River. As the frontier population and ranching industry expanded, bighorn numbers were reduced because of over-hunting and competition with domestic livestock. Desert bighorn disappeared over most of their range. Only small isolated groups were found in the southernmost mountain ranges. There, conditions were too severe for domestic livestock or large settlements. Wildlife interest groups, federal agencies, and the NDOW have reintroduced desert bighorn into most of their former range. The population has grown to approximately 5,000 animals.

Similar efforts for California bighorn sheep and Rocky Mountain bighorn sheep have resulted in stable populations of these animals in suitable habitats throughout the state (Table 3-3). Mountain goats and Rocky Mountain elk have also been successfully introduced into Nevada. Exotic mountain goats are found in the East Humboldt and Ruby mountain ranges in Elko County. The special habitat requirements for goats limit their range substantially. Exotic mountain goat populations are estimated at 260 animals. Elk, which do not have such special habitat requirements, are currently found in several locations in northeastern and central Nevada. Elk populations continue to expand due to immigration from adjoining states, growth of established herds, and transplanting by the NDOW. About 5,700 elk currently inhabit the state.

Table 3-3. Large Mammal Population Estimates for Select Years

Year	Mule Deer	Pronghorn Antelope	Elk	Desert Bighorn	California Bighorn	Rocky Mtn. Bighorn
1990-91	180,000	18,500	2,400	3,996	-	-
1995-96	132,900	14,800	4,000	4,945	1,085	329
1999-00	145,000	16,000	5,700	5,000	1,400	250

Source: Nevada Division of Wildlife, 2000.

Mule deer is the most common wild ungulate found in Nevada today. However, mule deer numbers were much lower prior to settlement. Wildlife biologists relate the "explosion" of mule deer during the first half of the 1900's to removal of woodlands, forests, and native grasses and replacement by shrub-dominated communities. The vegetation changes came about primarily by excessive livestock grazing and clear-cutting of trees for mines, mills, and towns. Also, deer predation by mountain lions was sharply curtailed while aggressive hunting, trapping and poisoning occurred. In 1988, the statewide deer population hit a record peak of 251,000 animals. Subsequently, a seven-year drought followed by a severe winter reduced the population by half. In 2000, wildlife biologists estimated 145,000 mule deer inhabited the state. Herd sizes naturally fluctuate with extreme weather and corresponding changes in habitat conditions (Nevada Division of Wildlife, 2001). Longer-term changes that affect the suitability of rangeland for large deer herds include nonnative plant invasions (especially cheatgrass), and large wildfires, and overcrowded forest and woodlands.

American pronghorn antelope inhabit expansive open rangelands throughout Nevada. Forbs and browse, including sagebrush, bitterbrush, and rabbitbrush, make up most of their diet. Pronghorn generally eat different plants than cattle. Sometimes they migrate between summer and winter ranges. Due to limited jumping capability, improperly designed fences can block their movement. During settlement of the West, pronghorn numbers declined from an estimated 35 million to 13,000. Populations are gradually rebounding after decades of complete protection and special management programs. Photo by Pete Rissler.

Pronghorn antelope are native mammals, unique in their ability to run fast and survive under harsh conditions. Reaching speeds of 60 to 70 miles per hour, the pronghorn is North America's fastest land mammal. Not a true antelope, the pronghorn is the only living representative of a group of ungulates that evolved in North America. The West-wide pronghorn population declined to critically low levels by the early twentieth century. Factors in their near demise were over-hunting, habitat conversion, and competition with livestock for food. During the 1990's, the state's population of pronghorn fluctuated, roughly in proportion to mule deer population changes (Table 3-3). Live trapping and transplanting along with habitat improvement projects, primarily guzzlers (i.e., small, artificial water development designed to trap and store runoff), help maintain pronghorn population and distribution. Their preferred shrub/grassland habitat consists of lower growing (less than 24 inches), well-spaced shrubs with plentiful forbs on rolling to flat slopes at low to moderate elevations. Fawns predation is likely to be higher where shrubs are overgrown. Improvements in grazing practices and management of livestock distribution can also improve the suitability of rangeland for pronghorns (U.S. Department of Agriculture, 2002).

Mountain lions and black bears are the largest predators in Nevada. Both are classified as game animals, though bear hunting is not allowed. Mountain lions are widely distributed and are found in most mountain ranges. Region-specific annual quotas are set to control mountain lion sport harvest. Lions can also be hunted to protect livestock under the authority of depredation permits issued to the U.S. Dept. of Agriculture. The highest harvest on record occurred during the 1997-98 period, when 230 lions were taken by both sport and depredation hunters. In 1999-2000, 144 animals were taken. Mountain lion populations peaked in the mid 90's as the result of high mule deer populations and since have declined with deer numbers. Mountain lion are secretive, so the population is difficult to estimate. Overall, lions are believed to be secure and in balance with the prey base.

Black bears occupy a limited area of Nevada, mainly along the east side of the Sierra Nevada Range and in the Carson Range. In the Sierra Nevada and Carson Ranges, bear populations are at high densities. The number of confrontations between bears and humans is rising as western Nevada urban areas expand. Subdivisions built in the mountains and foothills encroach into bear habitat and displace food supplies. Residential, commercial, and campground developments often attract bears where garbage is not properly managed. Bears have adapted to the more reliable supply of garbage, and young bears are developing the same foraging habits. In addition, the intensity of backcountry travel and mountain oriented recreation has increased. The Nevada Division of Wildlife (NDOW) and the University of Nevada, Reno are currently studying the status and habits of black bears in the urban interface along the Sierra front and Tahoe Basin. The black bear population is estimated to exceed 200 animals.

A variety of mid to small sized mammals inhabit the state. In addition to fur bearers listed in Table 3-4, other mid to small sized mammals include river otter, pine marten, ringtail, weasel, and ermine are other mid to small sized mammals. In some situations these mammals are seen to be a nuisance, but overall they are critical to healthy ecosystems. For example, beaver and muskrat are removed from irrigation and domestic water systems to alleviate disease concerns and to prevent damage to water distribution structures. However, ponds created by beaver dams create special aquatic and riparian habitats and

enhance water resources. The carnivorous furbearers keep populations of rodents and rabbits in check, and some eat carrion, which may otherwise be a source of disease.

Table 3-4. Fur Sales in Nevada 1999-2000

Species	Number Sold
Bobcat	691
Coyote	243
Grey Fox	147
Kit Fox	39
Beaver	112
Muskrat	979
Mink	2
Badger	13
Raccoon	18

Source: Nevada Trappers' Association.

Ten mammals are classified by NDOW as furbearers. Historically, furbearers were important commercial species. In recent years, market demand for fur has decreased significantly, lowering commercial trapping activity (Table 3-4). Relatively little biological information is available on these important mammals.

Many small mammal species inhabit a great variety of niches, from (sub)alpine mountaintops, along riparian zones, to sand dunes. Of the nine mammal species and subspecies endemic to Nevada, the only full species is the Palmer's chipmunk (*Tamias palmeri*). It lives in the Spring Mountains, near Las Vegas. Palmer's chipmunk is one of 16 North American mammal species that became isolated in "mountain islands" as the climate and vegetation shifted to drier conditions. Rodents, which include desert dwelling kangaroo rats and a variety of mice, rats, squirrels and ground squirrels, gophers, and voles, perform important ecological functions, such as seed dispersal and soil aeration. The range of a different type of beaver, the mountain beaver (*Aplodontia rufa*), extends into riparian areas of the Sierra Nevada's in western Nevada. Pygmy rabbits and five other species of rabbits and hares are widespread. The pika, a relation of the rabbit, occupies alpine talus slopes. Several species of shrews and one mole species also live in Nevada.

Twenty-three species of bats are found throughout the state. Bats are well known for their nocturnal feeding habits, consuming large quantities of insects. One species, the Mexican long-tongued bat (*Choeronycteris mexicana*) feeds on the nectar and pollen of Mojave Desert plants. All bat species are considered rare or sensitive (Nevada Natural Heritage Program, personal communication, 2002). However, only the spotted bat is designated as a threatened species and protected by state law. Bats inhabit or utilize many niches. These include abandoned mines, urban structures, caves, cliffs, springs, riparian, aspen, pinyon-juniper, and desert shrub habitats. Though bats benefit the environment and mankind in many ways, bats are misunderstood and feared. Unfounded fear coupled with habitat loss among other factors has caused many bat populations to decline. A bat conservation plan has been developed by the Nevada Bat Working Group, which includes the NDOW and NNHP (Bradley et al., 2002). The purpose of this Plan is to reduce the threats to bat populations and their habitats, and also to reduce the risk that any bat species in Nevada will require protection under the Endangered Species Act. Because bats are part of a much larger ecosystem, the goal of the Plan is to promote healthy bat habitats and stable and/or increasing bat populations throughout western North America.

Five mammal species are classified as protected and another as threatened. With the exception of the pika (*Ochontona princeps*), all mammals classified as protected inhabit the eastern Sierra Nevada ecoregion. The mammals are mountain beaver (*Aplodontia rufa*), Douglas squirrel (*Tamiasciurus douglasi*), northern flying squirrel (*Glaucomys sabrinus*), and western gray squirrel (*Sciurus griseus*). The spotted bat (*Euderma maculatum*) is the only mammal species designated as threatened in Nevada. Many wildlife species that inhabit the mountains around Lake Tahoe and the east Sierra Front are at the eastern edge of their range. The number of protected mammals highlights the unique biology of the mountain range, and the encroachment of urban development into wildlands.

Birds

Nevada is home to a large and diverse group of resident and migratory bird species. However, birds are mobile, so none of the 283 native species are considered endemic. The popularity of bird watching has grown steadily. Premier bird viewing areas can be found throughout the state, including urban areas

such as Oxbow Nature Center in the heart of Reno and the Henderson Bird Preserve in the Las Vegas metropolitan area. Large wetland complexes in northwestern and northeastern Nevada attract large populations of many migratory shorebird, waterfowl, and wading bird species. The Bird Conservation Plan (1999), prepared by Nevada Partners in Flight, provides comprehensive information about nongame birds that are of special conservation concern (Table 3-5).

Table 3-5. List of Species of Concern in the Nevada Partners in Flight Bird Conservation Plan (1999)

Greater Sandhill Crane	White-faced Ibis	Snowy Plover
American Avocet	Black Tern	American White Pelican
Clark's Grebe	Long-billed Curlew	Northern Goshawk
Prairie Falcon	Ferruginous Hawk	Cooper's Hawk
Swainson's Hawk	Short-eared Owl	Burrowing Owl
Flammulated Owl	Orange-crowned Warbler	Black-throated Gray Warbler
MacGillivray's Warbler	Virginia's Warbler	Lucy's Warbler
Grace's Warbler	Wilson's Warbler	Black Rosy Finch
White-headed Woodpecker	Western Bluebird	Cooper's Hawk
Southwestern Willow Flycatcher	Olive-sided Flycatcher	Ash-throated Flycatcher
Gray Flycatcher	Willow Flycatcher	Lewis's Woodpecker
Red-naped Sapsucker	Western Yellow-billed Cuckoo	Bobolink
Bank Swallow	Blue Grosbeak	Yellow-breasted Chat
Phainopepla	Loggerhead Shrike	LeConte's Thrasher
Scott's Oriole	Calliope Hummingbird	Vesper Sparrow
Black Rosy Finch	Juniper Titmouse	Pinyon Jay
Gray Vireo	Sage Sparrow	Sage Thrasher

Source: Nevada Working Group, Partners in Flight, 1999.

State wildlife regulations classify birds as upland game, migratory game, protected, or unprotected. Continental and local declines in numerous bird populations have led to concern for the future of migratory and resident bird species, regardless of game of nongame designation. The reasons for declines are complex, largely the result of habitat elimination, conversion, and fragmentation, including critical wintering and migratory habitat. With data on nongame birds sorely lacking, scientists, government agencies and the concerned public have become engaged in conservation initiative focusing on nongame landbirds, waterfowl, and shorebirds. Collaborative conservation and data collection efforts include the Nevada Working Group of Partners in Flight, the Great Basin Bird Observatory, and the Intermountain West Joint Venture component of the North American Waterfowl Management Plan (Nevada Partners in Flight, 1999).

Fifty game bird species may be found in the state, many of which are introduced. Sixteen birds are classified as upland birds, of which eight are native to Nevada and eight are introduced. The native game birds are Sage Grouse, Blue Grouse, Sharptail grouse, Mountain Quail, and Gamble's Quail. Greater Sage Grouse numbers and distribution have declined throughout Nevada and the western U.S. As with other species in decline, a major factor is habitat loss or alteration - the cumulative effects of land and water development that, in this case, converted and fragmented the Great Basin sagebrush and sagebrush steppe ecosystems. Historic grazing, cheat grass, and wildfires are among the negative impacts. Nevada Sage Grouse have a stronger reliance on wetlands and riparian areas for their survival, due to the short precipitation season. Since 1970, Greater Sage Grouse numbers have decreased between 49 and 60 percent. Meanwhile hunting harvest declined by 72 percent. A statewide strategy was adopted in 2001 to establish regional cooperative working groups that will design and implement scientifically sound management plans to ensure that the Greater Sage Grouse and healthy habitat areas does not continue to decline (Nevada Division of Wildlife, 2001).

The Sage Thrasher requires dense stands of tall sagebrush. Breeding adults conceal nests in or underneath a shrub. An important characteristic for nest placement is consistent foliage density, which protects the young from temperature extremes and predators. Sage Grouse prefer low sagebrush expanses during portions of their life cycle. Sage Grouse and Sage Thrashers are examples of "sagebrush obligate" species with differing sagebrush habitat requirements. These differences exemplify one of the challenges in managing diversity within sagebrush ecosystems. Photo by Paul Slichter.

Several species have been introduced in natural and altered habitats (e.g., farmland) to provide more hunting opportunities. Chukar, originally from India and Pakistan, have adapted to the drier, rockier terrain of northern Nevada and are the most common upland game bird found in the state today. Hungarian partridge have been introduced into areas with similar habitats. The efforts of sportsmen's groups and the NDOW to build water collection devices in dry habitat have substantially increased the range and population levels of Chukar. A similar effort in southern Nevada has greatly expanded the range of Gamble's quail. Over 1,000 guzzlers have been constructed to provide water for wildlife in areas where natural supplies are limited or nonexistent. Himalayan Snowcock occupy a narrow habitat range above tree line in the Ruby and East Humboldt mountain ranges of Elko County. Ring-necked and White-winged Pheasants are imports from Asia and small numbers now inhabit agricultural valleys in northern Nevada. Wild Turkeys from Texas and California also have become established in several agricultural areas. California and Scaled Quail are also successful transplants to Nevada. Upland game bird population levels are highly influenced by climatic conditions. The NDOW uses annual hunting data to monitor population trends (Table 3-6). Biologists typically require more information than quotas and harvest data to evaluate the robustness or vulnerability of populations. Biological factors to consider include the quality and distribution of habitat conditions and the population size and trend of the species and its predators. Hunting factors could include weather and climate, hunting pressure, skill, and chance.

Table 3-6. Upland Game Bird Harvest for Selected Species

Year	Sage Grouse	Blue Grouse	Chukar	Quail	Pheasant
1969	23,270	767	124,353	107,287	2,938
1979	28,228	3,123	151,270	171,972	6,072
1989	9,445	2,303	82,464	30,632	1,246
1999	6,070	1,702	105,655	54,996	990

Source: Nevada Division of Wildlife, 2000.

Migratory game birds include species found in the Families Anatidae (wild ducks, geese, brants, and swans), Columbidae (wild doves and pigeons), Gruidae (little brown cranes), Rallidae (rails, coots, and gallinules), and Scolopacidae (woodcocks and snipes). These species depend on aquatic habitats and/or wetlands. Large numbers of each are found in the state during certain seasons as exemplified by estimated peak waterfowl populations shown in Table 3-7. Each year is different. Seasonal site-specific environmental conditions influence the abundance and distribution of different birds. Winter precipitation is an important short-term key to wetland habitat availability and maintenance. Significant wetland losses in the state have had an affect on water dependent bird populations, as well as other resident and migratory birds. For example, Mourning Dove and White-winged Dove populations fluctuate in response

to moisture dependent habitat conditions. Dove populations have shown a long-term downward trend, possibly due to changes in agricultural practices and drought years.

Table 3-7. Estimated Peak Waterfowl Population on Select State and Federal Wildlife Areas, 1988 – 1997

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Ducks	180,858	243,028	151,936	95,563	71,357	174,580	108,064	360,631	334,273	450,148
Geese	10,361	15,959	28,658	7,663	8,462	38,561	11,252	34,557	15,249	14,768
Swan	2,785	2,042	2,227	383	813	2.390	1,971	2,324	5,543	8,225
*Res. Storage	348,800	244,600	225,400	92,200	101,900	163,300	189,200	239,200	357,100	426,000

Source: Nevada Division of Wildlife
Note: * March 1 Reservoir Storage for Lahontan and Rye Patch Reservoirs

Approximately 235 non-game bird species occur in Nevada for all or part of their life cycle. This does not include the "accidental" occurrence of migrants that find their way here due to weather events or other misguidance. (In 2001, a Sabine's Gull, an arctic open-ocean bird, was observed in northwestern Nevada.) Historical information on the populations and trends of most nongame birds is quite limited. Birds occur in all habitats and life zones with the largest number of species utilizing water-associated habitats.

Twenty-five species of raptors are represented in Nevada, and a major raptor migratory corridor passes through the state. Favorable wind patterns tend to funnel major migrations of raptors through concentrated areas, making Nevada one of the premier spots to watch and monitor migrating raptors. Spring and fall migrating raptors are regularly monitored at Goshute Peak in eastern Nevada. Raptor populations are useful to wildlife researchers because they provide clues about the health of the environment. Raptors are also popular with wildlife watching and photography enthusiasts.

Passerines (i.e., perching songbirds) such as warblers, sparrows, finches, and flycatchers comprise 60 percent of the non-game species. Water and shorebirds, cranes, woodpeckers, hummingbirds, swifts, and kingfishers are among the other groups represented in our state. All wild birds, with the exception of the starling and house sparrow, are covered by the Federal Migratory Bird Treaty Act, and are further protected from shooting or capture by State wildlife regulations.

Amphibians and Reptiles

Sixteen native amphibians occur in the state. Amphibians generally require access to water and/or moist habitat conditions throughout their life cycle, and therefore are limited in number and distribution in Nevada. The Vegas Valley leopard frog (*Rana fisheri*), one of six native frogs, has gone extinct. The bullfrog (*Rana catesbeiana*) is one of two introduced amphibian species. It has become a dominant species in marsh and pond habitats, and preys on the young of native amphibian, fish, and reptiles. The bullfrog is the only amphibian game species. Two other native frog species, the relict leopard frog (*Rana onca)*, and the Columbia spotted frog (*Rana luteinventris)* are classified as protected by state law.

The Amargosa toad (*Bufo nelsoni*) is one of nine native toad species. It is the only one classified as state protected. The toad is endemic to a small area in the Oasis Valley in the midst of the Amargosa Desert (southern Nye County). While springs and ponds are essential habitat for young toads, adults can tolerate drier habitat patches. Adults find shelter under bushes, woody structures, rocks, and rodent burrows. In the past, the limited habitat for this species was subjected to a variety of land disturbances that threatened its existence. A cooperative planning process involving federal and state agencies, Nye County, The Nature Conservancy (TNC), ranch owners and others produced a species conservation agreement. The Agreement sets specific conservation actions for the long-term survival of the toad. TNC also acquired a Wetland Reserve Program easement from a ranch owner, in concert with the Nevada NRCS. Other native toads occupy a variety of habitats, some relatively common and widely distributed, and others rare with narrow ranges.

The state's desert habitats are well suited to the 54 native reptile species. Thirty-six species are allowed to be collected commercially with a permit from NDOW. Commercial collectors provide reports on the number of reptiles collected. In the period 1992-1997, 138,871 individuals were collected; an amount 10 times greater than the quantity taken between 1986-1991 (10,679 individuals). Ninety percent of the collected reptiles consisted of four species that occur in northwestern Nevada. Baseline population and distribution data are lacking for most reptile species, so the long term effects of commercial collecting and unlimited reptile harvesting are unclear.

The relict leopard frog, similar to the Amargosa toad, inhabits wetland patches in the Mojave Desert that contracted as the climate warmed and dried during recent millennia. More currently, water diversions and dams have impaired remaining habitat patches. Early records indicated the relict leopard frog lived in 64 locations. The species was thought to be extinct for 40 years until the 1990's, when eight populations were found. Two have been lost since then. Surviving populations are located at springs on the Lake Mead National Recreation Area. Agencies, such as NNHP, provide current information on the status, biology, and threats to sensitive species populations, an important step in conserving the state's biodiversity and avoiding strict regulations. Photo by Ross Hayley, NPS.

Two fully protected reptiles are the desert tortoise (*Gopherus agassizii*) and the banded Gila monster (*Heloderma suspectum cinctum*). The desert tortoise is the state reptile. It is federally listed as a threatened species. Special adaptations have enabled the tortoise to live in the extreme heat and dryness of the Mojave Desert ecoregion, such as being diurnal (i.e., an early bird and night owl), a thick shell to conserve water, and the ability to excavate their own burrow in order to beat the heat of the day. The Clark County Multi-species Habitat Conservation Plan is intended to protect desert tortoise and other special status species of the Mojave Desert at risk from rapid development, off-highway vehicle use, and other urban related threats.

Fishes

Ninety-one native fishes occur in a variety of aquatic habitats. Of that total, 53 are endemic species and subspecies. The number of fishes unique to Nevada is large because thousands of year ago, large postglacial lakes and streams receded. Remnant water bodies became more isolated as the climate became increasingly arid. Over time, separated populations of fish species adapted to changes in stream flow quantity and patterns as well as changing water quality conditions. During centuries of isolation and adaptive change, surviving fish species became genetically unique. Some very rare fishes live in a single spring or stream.

One of many examples is the Devils Hole pupfish, which lives in one deep-water pool at Ash Meadows National Wildlife Refuge. The pupfish was nearly extirpated in the 1970's when the level of the pool was drawn down by pumping from groundwater wells near Ash Meadows. Native fishes living in small water bodies are all the more vulnerable to the combined threats of drought and human activities that change the amount of water in the system, modify the habitat, or introduce more competitive foreign species. The Devils Hole pupfish is one of thirty-two fish species classified as protected, threatened, or endangered by state law. In addition, 11 fishes are designated sensitive by state law (Nevada Administrative Code 503.065). Sixty-three taxa are considered rare or sensitive by the NNHP.

More than 200 reservoirs and lakes and 500 streams are distributed throughout the mountains and valleys. A variety of cold and warm water fisheries are maintained for angling. Many species of non-native game fish have been introduced into these waters. Notable game fish are rainbow, brook, and brown trout, largemouth bass, several species of catfish, perch, walleye, and striped bass. Another introduced species, the carp, was originally hailed as a fabulous food and game fish. Now ubiquitous, carp have proved to be a scourge and virtually impossible to eradicate. Most sport anglers concentrate on non-native species, populations of which are either self-sustaining or supplemented by hatchery stock.

The Lahontan cutthroat trout (LCT) is the state fish. Native to the Great Basin, the LCT was once widely distributed throughout northern Nevada. A close relative is the Bonneville cutthroat, which populates mountain streams and lakes within the Lake Bonneville Basin in easternmost Nevada. The LCT has a lacustrine (lake dwelling) and a fluvial (stream dwelling) form. The lacustrine strain lives in Pyramid, Walker, and Summit lakes. The fluvial (stream dwelling) fish occurs in the Humboldt River system, isolated streams in northwestern and central Nevada, and tributaries of the Truckee, Carson and Walker River tributaries.

Lahontan cutthroat trout, a native of desert and montane streams and lakes, occupies only about 10 percent of its historic habitat. In many places, stream and lake ecosystems are impaired by changes in water quantity and quality, channel structure and stability, riparian plant cover, and nonnative fishes. Other sensitive native trout species, such as Bonneville cutthroat trout, inland Columbia Basin redband trout, and bull trout, exist in similar limiting conditions. Cooperative restoration projects on Marys River, Eightmile Creek, Maggie Creek, East Fork Quinn River, and others show streams can be mended to benefit fishes, songbirds, waterfowl, wading birds, upland birds, and mammals. Conditions for outdoor recreation and grazing also improve. Photo by Pete Rissler.

The FWS designated LCT as a threatened species because populations throughout much of its native range have been eliminated. Reasons for this decline include alteration of stream channel and riparian habitats; water diversions that reduce stream flow and lake levels; impaired water quality in lower river reaches and terminal lakes (e.g., Walker and Pyramid lakes); dams and other obstructions to migration; and, the introduction of non-native game fishes and other competitive animals. Substantial efforts to improve the fisheries and increase the number of water bodies maintaining reproducing LCT populations have been undertaken by the FWS, NDOW, Pyramid Lake and Summit Lake Paiute Tribes, and others. Gains have not been sufficient to remove LCT from the Endangered Species List. An implementation plan for the improvement of the Truckee River system is being developed to assist in the recovery of the LCT and endangered cui-ui. Maintenance of recreational fishing opportunities is a goal of the planning process. A planning process has also been initiated by the FWS for LCT in the Walker and Humboldt River systems and in northwestern Nevada (U.S. Fish and Wildlife Service, 2001).

To sustain popular lake and reservoir fisheries, resource agencies in Nevada operate seven fish hatcheries and rearing stations. Three are run by NDOW (Mason Valley, Lake Mead, and Gallagher near Elko), three by the Pyramid Lake Paiute Tribe (Dave Koch and David Dunn at Sutcliffe, and Numana near Wadsworth), and one by the FWS (Lahontan, near Gardnerville). Native fishes on the Endangered Species List and introduced species are produced at the hatcheries. The April 2001 NDOW fish stocking update reported over 51,500 rainbow and brown trout, and almost 82,800 hatchery-reared Lahontan cutthroat trout were planted in Nevada waters. Almost all the cutthroat trout were placed in Walker Lake, with a small fraction going into Topaz Lake. About 99 percent of the other trout species were planted in 15 lakes and reservoirs located in both rural and urban areas. The Carson and Truckee rivers received the remaining one percent. In a May 2001 update, NDOW reported planting another 200,000 rainbow, brown, and rainbow-cutthroat hybrid trout were planted in many rivers, creeks, and reservoirs. The NDOW data do not include fish plantings by the Pyramid Lake Paiute Tribe nor the FWS.

Other groups of native fish species include various minnows, (e.g., dace, chubs, shiners) (*Cyprinidae* Family), suckers (*Catostomidae* Family), pupfishes (*Cyprinodontidae* Family), and several springfishes and poolfishes (*Goodeidae* Family). Like many other fishes, these have evolved into numerous distinct forms in isolated water bodies. For example, the nearest relative of poolfishes in Nevada occurs in central Mexico, and nowhere else in the U.S. An important lakesucker species is the cui-ui, unique to Pyramid Lake and important to the Pyramid Lake Paiute Indian Tribe. The cui-ui population declined early in the 1900's when dams, diversion, channel erosion, and delta formation blocked access to

essential fresh water spawning habitat in the lower Truckee River. Cui-ui are hatched and reared at the Dave Koch hatchery as part of the effort to recover this endangered species.

Invertebrates

An overlooked group of organisms is our invertebrate population. Although there is much to still be learned, worldwide diversity among this group is probably higher than all other wildlife combined. Invertebrates occupy virtually all habitat types even lightless caves, alpine tundra, and searing sand dunes. Invertebrates play a critical role in pollination and are an essential food source of insectivorous predators higher on the food chain.

Butterflies are a relatively well-known group of invertebrates. Nevada ranks ninth among all states in the diversity of resident or regularly occurring colonies of butterflies. Butterflies are found in almost every habitat type. Some butterflies, such as the painted lady (*Vanessa cardui*), are migratory, while others are specialized residents of narrow habitat types. Incredibly, the Sand Mountain blue (*Euphilotes pallescens arenamontana*) inhabits only one sand dune in Churchill County. In addition to the showy characteristics and bright colors that provide us with an immeasurable aesthetic resource, butterflies also perform the critical ecological function of pollinating many types of plants. There are approximately 200 species and 170 additional subspecies of butterflies known to exist in Nevada. Thirty-one taxa are endemic. In most cases, butterflies rely on only one or a few closely related plant species to feed and lay their eggs. In central Nevada mountain riparian zones, the Apache silverspot butterfly (*Speyeria nokomis apacheana*) requires a single violet species during its larval stage, and four thistle species for nourishment as an adult. The high degree of habitat specificity makes such butterfly species all the more vulnerable.

The Apache silverspot butterfly is being studied in the Toiyabe mountain range of central Nevada. Biologists are learning about factors affecting the absence or presence of breeding populations of animal species requiring specific habitat types. Field research shows the Apache silverspot is very particular about plants used during life cycle stages. Suitable breeding habitat patches contain a singular violet species and select thistle species that co-occur in riparian areas. The study found that the presence of breeding populations was more related to plant composition and vegetation structure than the size or proximity of suitable habitat. Such research provides valuable information to land use managers responsible for sustaining sensitive species, among other conservation goals. Photo courtesy of Erica Fleischman, Stanford University, Center for Conservation Biology.

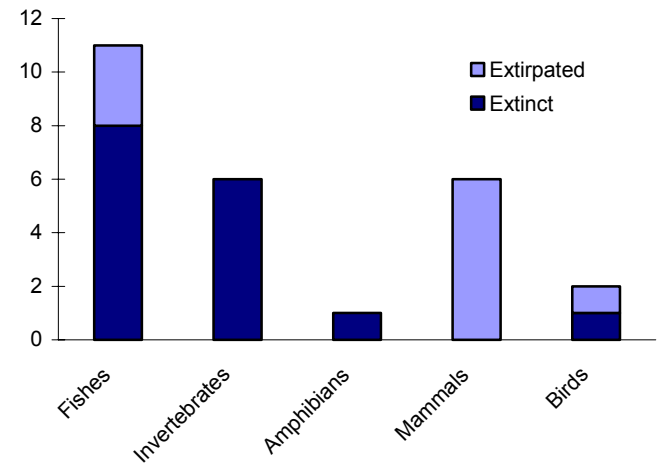
Springsnails are an interesting group of invertebrates. These freshwater, gill-breathing mollusks occur throughout North America, primarily in springs. In Nevada, many species specialize in extreme habitats including springs with temperatures ranging from 37º F (3º C) to 111º F (44º C). More species of *Pyrgulopsis*, the largest genus of springsnails, occur in the Great Basin than anywhere else in the U.S. Most springsnail populations are highly isolated because springs and seeps are widely dispersed and disconnected. Indeed, many species' entire range is in just one small spring. A number of springsnail populations are declining, almost faster than we can learn about them. Their aquatic habitats are rare and sensitive to drought and to the manner in which water resources are used.

Much remains to be learned about the diversity of Nevada's invertebrate populations, their distribution, conservation status, and special ecological functions. Currently, no invertebrates are afforded state protection. As scientists continue to monitor and survey populations, undoubtedly new species will be described and more will be learned about Nevada's exceptional diversity.

Endangered, Threatened, and Sensitive Fauna and Flora

The loss of plants and animals changes ecosystem functions in ways difficult to predict or observe, until serious impacts arise. Once species have been eliminated from the state or even a portion of the state, restoring the lost species and ecological functions may be difficult, if not impossible. An example is the removal of perennial grasses and forbs from large portions of Nevada's sagebrush and sagebrush steppe vegetation zones. As shrubs and cheatgrass filled the voids, the stage was set for large, intense wildfires and the accelerated invasion of non-native annual weeds and grasses. Actions that subtract species from the total mix of native plant and animal communities are not small matters.

Figure 3-3. Nevada Wildlife Losses



Source: Nevada Natural Heritage Program, 2001.

The use and development of Nevada's natural resources unfortunately has resulted in losses of native fishes, mammals, and birds. Many animal species have become extinct or have been extirpated (i.e., no longer inhabit Nevada, but still occur elsewhere) (Figure 3-3). A total of 26 taxa no longer exist in Nevada. Sixteen are extinct and ten are extirpated. A majority of the extinct species lived in aquatic environments, including springsnails, fishes, and one amphibian. These losses highlight the sensitivity of these ecosystems to dewatering, as well as the alteration of stream channels and riparian vegetation. As the growing population and economy increases demands placed on Nevada's limited water resources, there is a corresponding need for innovative water management solutions to sustain aquatic habitats and species from additional losses. Currently, records do not indicate that any plant species has been completely extinguished from the state. However, many plant species are declining and no longer occupy much of their former range.

Threatened and Endangered Species

Forty plant and animal species or subspecies are on the federal List of Endangered and Threatened Wildlife and Plant Species. Overall, 644 taxa are considered rare or sensitive in Nevada (Table 3-8). The loss and fragmentation of native habitats and competition by nonnative species are the biggest threats to biodiversity. Activities associated with habitat loss and deterioration include urban sprawl; surface water diversions; overgrazing by domestic and wild animals; mineral development and exploration; and concentrated outdoor recreation, especially involving careless off high vehicle use. Wildfires and non-native plant invasions have destroyed millions of native habitat acres in recent years. Proactive habitat conservation has become vitally important.

The regulatory approach to conserving Nevada's most imperiled plants and animals is based on federal or state programs that designate, study, and plan for the protection and recovery of threatened and endangered species and their habitats. The U.S. Fish and Wildlife Service (FWS) administers the federal Endangered Species Act of 1973 (ESA), as amended. As the lead agency for ESA implementation, the FWS has responsibility for ensuring that threatened and endangered species will be sufficiently protected and can survive in their natural habitat. Public or private land use activities that may jeopardize listed species must be permitted and a plan approved to avoid, minimize, or mitigate the taking of individuals of endangered or threatened species. Endangered means a species of plant or animal is in danger of being eliminated throughout all or a portion of its range. Threatened means a species is likely to become endangered in the foreseeable future. The FWS has designated, or "listed", 24 distinct Nevada taxa as

endangered and 16 as threatened (Table 3-8). In addition, the BLM and the USFS manages 234 sensitive and rare taxa.

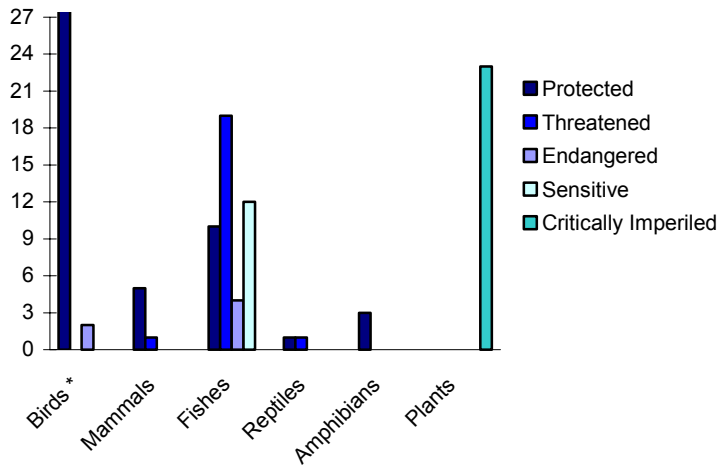
Table 3-8. Number of Rare and Sensitive Taxa in Special Protection Designations by Federal and State Agencies In Nevada

	FWS Threatened or Endangered	BLM Sensitive and Rare	USFS Sensitive and Rare	NDOW & NDF State Protected	NNHP Sensitive and Rare
Amphibians	0	3	3	3	6
Birds	6	35	17	30*	48
Fishes	23	48	13	45	61
Mammals	0	19	13	6	40
Reptiles	1	3	2	2	6
Invertebrates	1	38	3	0	169
Plants	9	129	103	25	297
Total	40	275	154	111	627

Sources: Nevada Natural Heritage Program website: www.state.nv.us/nvnhp.
Note: *Nevada Administrative Code 503.015 through 503.080 protects all nongame birds that are protected under Federal laws, in addition to the 30 species listed.

Of the 40 species federally listed as endangered or threatened, 37 are protected under state statutes and regulations administered by NDOW and NDF. Under state law, a species may be designated as protected, threatened, endangered, or sensitive. Capturing, removing or destroying plants and animals on the state's fully protected list is prohibited unless a special permit has been obtained from the state Divisions of Forestry and Wildlife. Of the 86 wildlife species protected under Nevada Administrative Code 503.050, most are fishes (45) and birds (30) (Figure 3-4, Table 3-7).

Figure 3-4. State Protection Designations for Flora and Fauna



Source: Nevada Natural Heritage Program, 2001.
Note: *NAC 503.050 protects all nongame birds that are protected by Federal laws in addition to the 30 species included.

The NDF administers a regulatory program (NRS 527.270, NAC 527.010) that requires a permit to be obtained prior to removal or destruction of any of the 23 "critically listed" native flora species or its habitat. Adoption of new regulations during 2000 for the native flora program provides for establishment of special management areas for critically endangered plants. Specific management area plans are required so that native flora can be protected while land and resource uses can continue.

An example is the Steamboat buckwheat (*Eriogonum ovalifolium* var. *williamsiae*), which occupies a single site in the Steamboat Springs geothermal area of Washoe County. An established management area and plan provides for the coexistence of an operating geothermal power plant and the habitat conditions necessary for plant population survival. Plants may be removed from the state protected list. In 2001, the NDF and NNHP de-listed two plants, Beatley milkvetch (*Astragalus beatleyae*) and Ruby Mountain primrose (*Primula capillaries*). These endemic species are no longer considered at high risk because land use and management changes have alleviated threats.

Table 3-9. Cactus and Yucca Harvest Permit Activity Level in Recent Years

Year	Harvest Permits	Tags	Shipping Permits
1990	14	2,924	60
1995	18	3,848	104
2000	14	4,715	84

Source: Nevada Division of Forestry, 2000.

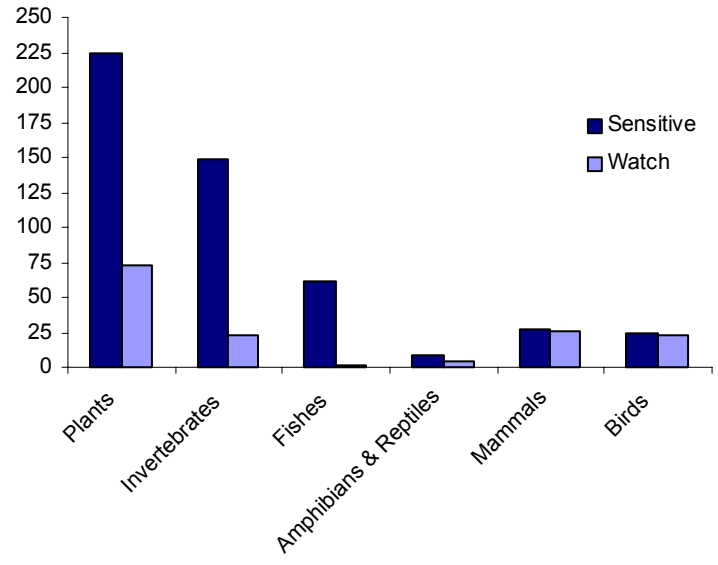
Cactus and yucca species found in the Mojave Desert ecoregion are in high demand for landscaping. To ensure that the number of cactus and yucca plants removed does not put the species at risk, permits must be obtained from NDF to harvest cactus and yucca species, such as Joshua trees, on private lands destined for development. Though the number of harvest permits issued remains relatively constant, the quantity of tags given for individual plants has increased over 60 percent since 1990 (Table 3-9.). Surveys have not yet been conducted to determine the appropriate population level of these species.

Thousands of cactus plants are taken illegally from public lands. On BLM managed land, all collectors are required to obtain a permit prior to harvesting cactus or yucca. The BLM only permits harvesting on land that will be permanently disturbed. Owners of projects on BLM land must salvage the plants, which are used by the BLM for site restoration, often in desert tortoise habitat. The cactus theft problem is serious enough for the National Park Service to implant computer-tracking chips into larger barrel cactus where poaching is high on the Lake Mead National Recreation Area. The BLM also has identified poaching hot spots. One is near Searchlight where hundreds of exposed 'cactus butts' have been found. BLM intends to install and maintain education signs in these areas.

Rare and Sensitive Species

As part of the state's early warning system for the conservation of biodiversity, the Nevada Natural Heritage Program (NNHP) tracks more than 600 rare and sensitive taxa (i.e., species and subspecies). This is accomplished through well-established biological inventory methods and data sharing with the member agencies of the Nevada Biodiversity Initiative and other collaborators. Nationally, the state Natural Heritage Program network is recognized as the leading source for detailed information on rare and sensitive plants and animals, and on identification of biodiversity "hotspots." The Heritage method, which is used nationwide, is followed to evaluate the relative risk of extinction using data on the number and condition of populations and individuals; the area or range occupied by the species; population trends; known threats; and protection or management status. Biologists evaluate each species against these risk factors based on the best available scientific information and assign the appropriate "rank". Ranks are classified globally and within individual states as secure, apparently secure, vulnerable, imperiled, critically imperiled, possibly extinct, and presumed extinct. Extensive files are maintained on the biology and mapped locations for each sensitive species.

Figure 3-5. Nevada Natural Heritage Program Sensitive and Watch Taxa



Source: Nevada Natural Heritage Program, 2001.

Using the Heritage method of assessing biodiversity significance, the NNHP identifies 493 sensitive species (Figure 3-5). Taxa classified as sensitive include those with federal or other Nevada agency status, and those ranked as vulnerable or of greater risk, or experiencing downward trends indicating some level of range-wide imperilment. In general, a sensitive species is any taxon whose long-term viability has been identified as a concern. Sensitive species are

widely distributed throughout the state (Figure 3-6). A separate Watch List includes taxa that could qualify for the sensitive list in the future, or that recently have been removed from the sensitive list. NNHP passively accumulates data for watch list taxa. The watch list consists of 151 taxa (Figure 3-5).

A state-by-state assessment recently published by NatureServe, the parent organization of the Natural Heritage Network, provides a relative ranking of states using measures of biological conditions – diversity, risk, endemism, and extinctions (NatureServe, 2002). Of the 50 states, Nevada ranked 11th in species diversity; 3rd in rarity and risk level; 6th in endemism (taxa unique to Nevada); and, 11th in extinctions. The 3rd rank in the rarity and risk measure can be attributed to the relatively large percentage of native fishes, amphibians, plants, and birds that are considered to be vulnerable, imperiled, or critically imperiled.

The NNHP, working with biologists and resource managers from many organizations, identifies landscape units that contain assemblages of sensitive species. The Natural Heritage Scorecard reports on particular conservation sites defined by occurrences of sensitive species that are appropriately managed as a unit based on common biological, land-ownership, and conservation-planning criteria. Sites with high diversity, protection urgency, and adaptive management requirements become the highest priority conservation sites. Scorecard 2000 brings attention to a total of 66 sites (Figure 3-7). Many of the Scorecard sites are associated with unique water and spring systems and sand dunes in rural areas. Others are near rapidly growing urban areas (Nevada Natural Heritage Program, 2000). The Scorecard, sensitive and rare species rankings and reports, and other biological resource assessments are performed by NNHP and made readily available. This information, when used in community master planning, land development project design, or public resource management can avert habitat loss or population declines in vulnerable species that trigger stringent federal or state regulations.

Coordinated planning and cooperative management to conserve special status species is growing. In southern Nevada, state, local and federal partners have prepared and are implementing the Clark County Multi-Species Habitat Conservation Plan. This far-reaching plan covers 78 different taxa and identifies the needed management and monitoring actions for a variety of habitats including low elevation uplands, desert riparian habitats, low elevation springs, and low elevation plant species.

To avoid further declines in Greater Sage Grouse populations in the northern half of the state, the Governor established a special task force office to prepare a state strategy. Sage Grouse populations have declined in different portions of its western U.S. wide range by 40 to 80 percent since the 1950's. The strategy emphasizes local collaborative conservation planning. The intention of enabling development of area-specific plans is to harmonize customary resource uses and locally meaningful incentives with actions to maintain good habitat conditions, improve degraded habitat, and stabilize, then increase, the bird's population.

Another instance of model collaborative conservation planning is development of the Nevada Bird Conservation Plan by the Nevada Partners in Flight (NPIF). Seeing indications of continent-wide and local declines in the population, distribution, and habitat of migratory and resident songbird and other species, the National Fish and Wildlife Foundation brought together federal, state, and local government agencies, foundations, conservation groups, industry and the academic community to form a program to address the problem. By 1993, interested parties coalesced into the Nevada Working Group of Partners in Flight.

During the next several years, ornithologists, wildlife experts, and bird watchers networked in the joint goal of developing a comprehensive bird conservation plan intended "to keep common birds common." A priority list of 46 species was developed for 15 major habitat types. Although long-term population data specific to Nevada were lacking for most of the priority species, population objectives were set for all species and then nested within one or more major habitat types. Strategies outlined how the objective could be achieved. The strategies usually address habitat management activities, but monitoring strategies and public awareness strategies also were deemed necessary. In all, 63 bird conservation objectives were set. The plan creates a modern day baseline for species monitoring and specific long-term goals

Figure 3-6. Mapped Distribution of Rare and Sensitive Species In Nevada

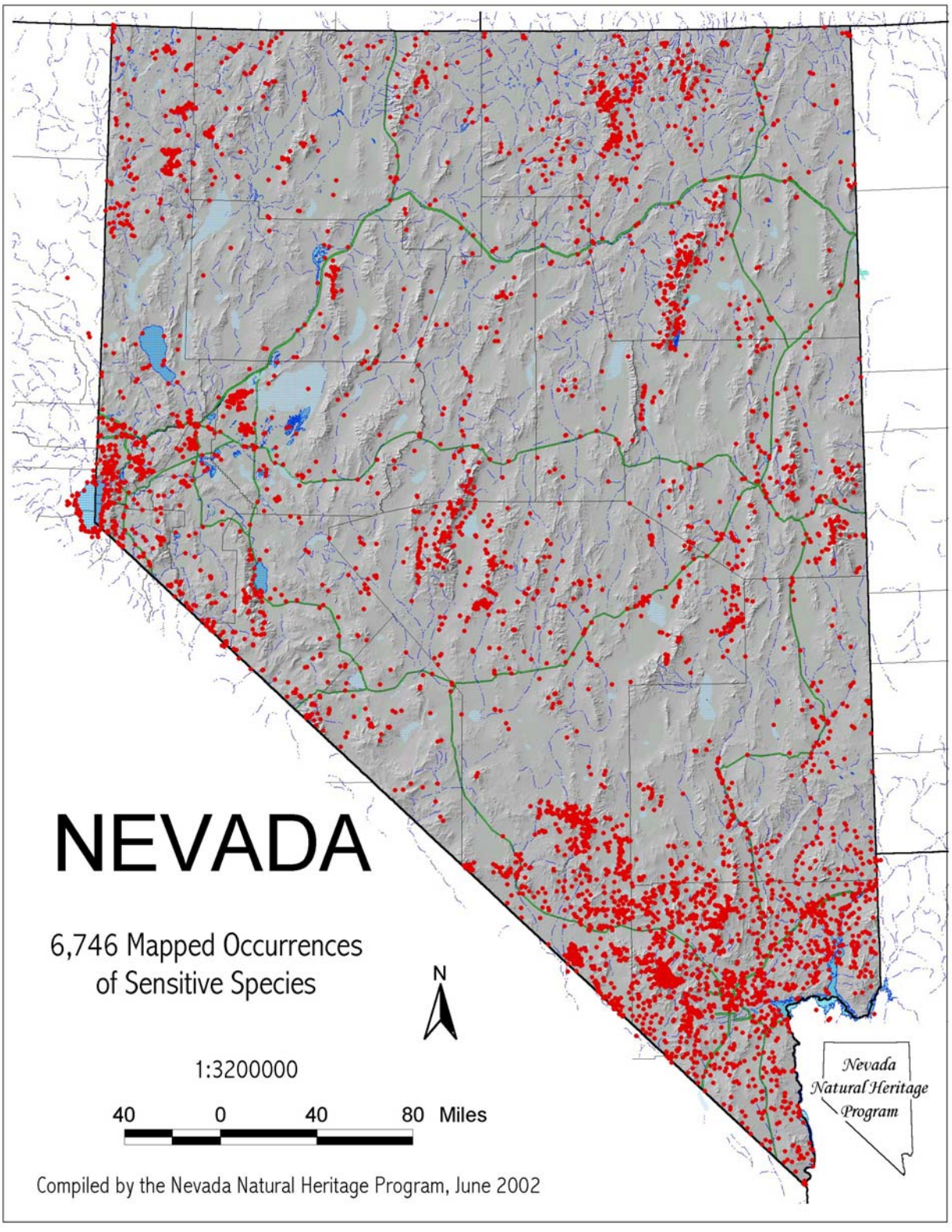
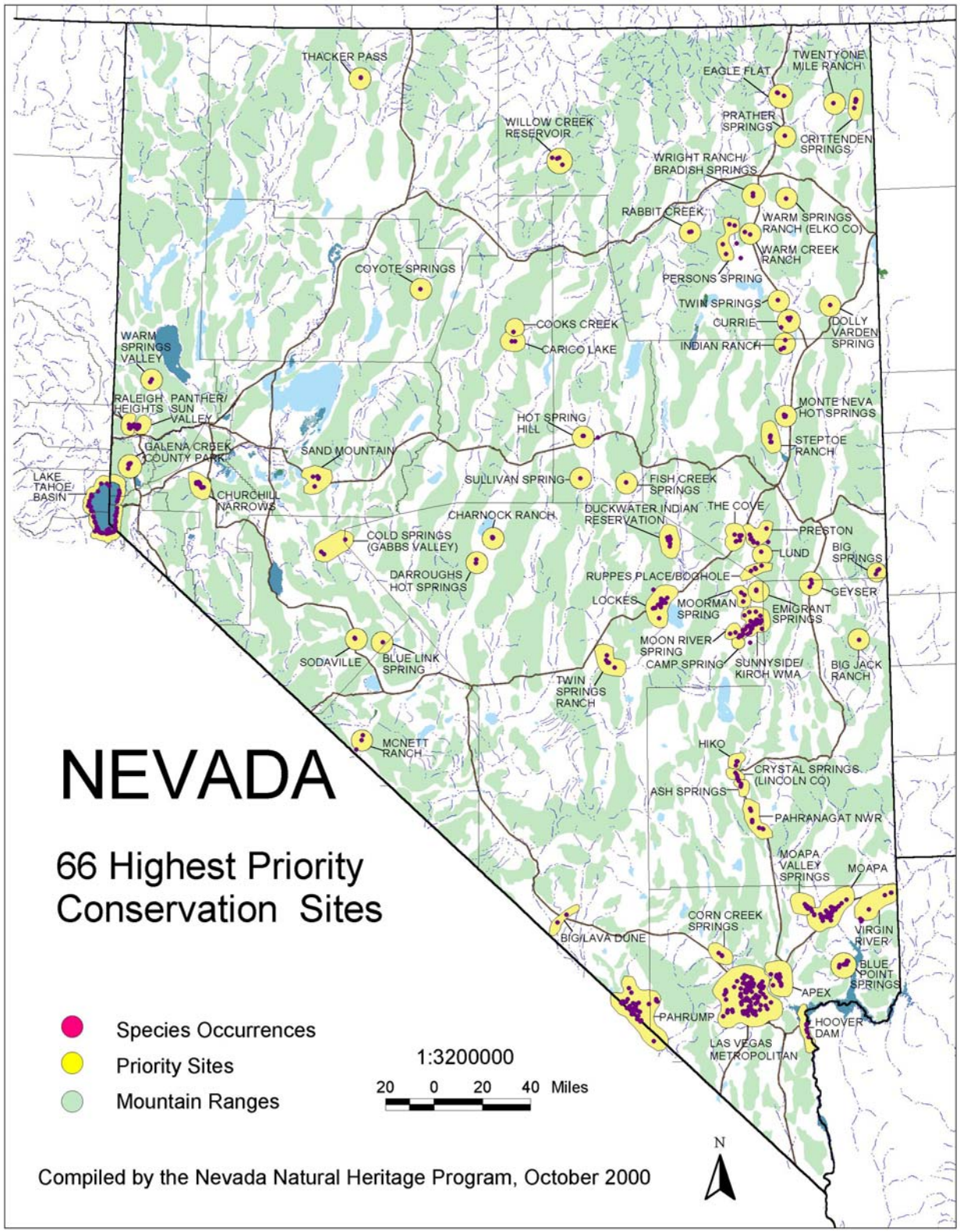


Figure 3-7. Highest Priority Conservation Sites in Nevada, 2000 Scorecard



For example, the Northern Goshawk and White-faced Ibis objectives are to maintain at least 300 and 4000 nesting pairs, respectively, in Nevada during the next three years. The White-faced Ibis is a priority species that occupies wetlands and lake habitats, nesting in colonies on sites with prolonged flooding to discourage predators and to prevent damage to their nests. Drought, water diversions, and thin eggshells from pesticides contributed to this bird becoming a species of concern. The Northern Goshawk inhabits aspen groves and coniferous forest, habitat types that are decreasing. Ultimately, the Nevada Bird Conservation Plan sets the stage for better stewardship and greater public awareness of the extraordinary bird life found in the state. Currently, NPIF is implementing a statewide all-bird monitoring program, which is being coordinated by the Great Basin Bird Observatory (GBBO).

In addition to the work being done by NPIF and the GBBO, Nevada has initiated an Important Bird Areas (IBA) Program. Through this program, locations with significant diversity of birds or large concentrations of single species are designated as an Important Bird Area. The Nevada IBA program is part of an international program. The over-arching goal of the Nevada IBA Program is to raise awareness of and promote enhanced management of IBA sites. The program will contribute to the preservation, maintenance, and recovery of bird populations in Nevada in collaboration with private landowners, federal and state agencies, and NGO's responsible for the well being of birds, wildlife and their habitats. The program started in Spring 2001, already has received recommended nominations for more than 50 sites.

Many people with different interests are striving to be better stewards of Nevada's living resources. The key to effective ecosystem management and sustaining biodiversity in concert with population and economic growth is collecting, sharing, and distributing information on the status of flora and fauna. Each year more is learned about the plants and animals that live here and about the ecology of native plant and animal communities. However, rapid population growth and changes in land use often outpace the ability of agencies to collect and analyze detailed data needed on the distribution and abundance of sensitive, as well as a wide range of other plants and animals.

More base-line data on common species would help ensure that management efforts are properly directed to truly vulnerable species. Also, coordination among environmental scientists and managers in different disciplines is needed to integrate data on the physical and biological components of ecosystems, to better understand the conditions which contribute to declining populations. More scientific information on causes for species imperilment will lead to greater certainty in conservation strategies. Increasing collaborative projects among government, industry, and conservationists is already bringing Nevadans closer to the goal of sustaining biodiversity while meeting the resource needs of urban and rural communities.

Wetlands, Riparian Zones, and Springs

Wetlands

Of the total wetlands that probably existed in Nevada prior to settlement, 52 percent have been lost (i.e., converted to another type of land cover or use) (Dahl, 1990). The largest regional wetland losses have occurred in the terminal basins of the Truckee, Carson and Humboldt rivers, where an estimated 82% of the wetlands have been altered (Thompson and Merritt, 1987). The distribution and size of wetlands naturally vary between wet and dry periods. Losses are primarily attributed to the diversion of streamflow for agricultural, municipal, and industrial uses; filling and draining wetlands for development; and, stream channel erosion and modification. Information on the ecological and water quality status is limited for most wetlands. Additional factors affecting wetland quality include: non-native plant invasions (e.g., tamarisk, perennial pepperweed, and hoary cress); discharges from irrigated farmland, abandoned mines, and urban stormwater containing high levels of salts and metallic compounds; and livestock and wild horse grazing that has not been properly managed.

Wetlands and riparian areas cover a relatively small amount of land in Nevada, but the benefits far exceed the area occupied. Wetlands are protected under the Clean Water Act and receive substantial attention from natural resource managers for several reasons.

- The diversity and abundance of vegetation and wildlife is higher in wetlands than any other ecosystem in Nevada.
- Water quality is better because lake and stream banks are more stable, vegetation provides cooling shade, and pollutants from surface runoff are filtered.
- Water is stored and released more slowly from channel banks and floodplains to adjacent waterways.
- Wetlands create habitat conditions required for the reproduction and survival of many fishes and other aquatic species.
- Recreation opportunities are high – hunting, fishing, wildlife watching, and scenery.
- Highly productive plant communities provide abundant forage and cover for the large number of wetland dependent wildlife

Different criteria are used by agencies to classify wetlands to reflect variation in statutory protection and management objectives. The US Army Corps of Engineers (USACE) has primary authority under Section 404 of the Clean Water Act for protection of "jurisdictional" wetlands – those that meet strict regulatory criteria for soil type, water dependent plant species, and period of saturated soils or inundation. The federal wetland policy of "no net loss" is not necessarily a one-for-one replacement objective. More acres may be required to be restored for mitigation than the amount drained or filled. The determination is based on an evaluation of the socioeconomic values and ecological functions of impacted wetlands. The federal policy and permit requirements may substantially deter unnecessary wetland losses.

Federal regulations provide for two permit types. A nationwide permit covers many routine land use activities that typically cause minimal impacts. An individual permit must be obtained for projects that could impact wetlands significantly. The process is involved, requiring application, public review and comment, scientific studies, and assessment of project alternatives to avoid, minimize, and mitigate impacts. The NDEP is involved in wetland protection through section 401 of the Clean Water Act. The provisions give the state's water quality standard setting agency the authority to deny projects in wetlands that could degrade water quality. During the period 1989 to 2000, the USACE permitted 700 acres of wetlands for conversion to another land use and required mitigation totaling 998 acres (U.S. Army Corps of Engineers, 2001). Mitigation data is not sufficient to determine whether there is a net gain or loss of wetlands. The USACE is working on improved enforcement and tracking of wetland mitigation projects.

The U.S. Fish and Wildlife Service (FWS) uses a broader definition of wetlands than the USACE for mapping wetlands. Riparian zones are more likely to be included in the wetland classification used by the FWS. State-by-state mapping was performed in the 1980's for the National Wetlands Inventory (NWI) project using aerial photographs shot in the summer from 1980 through 1986 and limited field verification. A statewide series of reconnaissance level (1:250,000 scale) wetland site maps was prepared. Five major categories of wetlands were identified:

- Wetlands less than 10 acres – a range of small and diverse wetlands such as vegetated springs and seeps, seasonally flooded vegetated wetlands, temporarily flooded unvegetated flats, and permanently flooded ponds. The size of individual wetlands could not be determined.
- Wetlands between 10 and 40 acres – the same types as the smaller size category of wetlands.
- Wetlands greater than 40 acres – classified based on vegetation or, if unvegetated, based on substrate. The total number of acres for these types was determined.
- Wetland/upland complexes – comprises several small wetlands too close to map individually.
- Linear wetlands (miles) – unvegetated, intermittent streambeds or woody or emergent wetlands in stream course or drainages.

The NWI mapping provides the only statewide statistics on wetlands available. About 1.7 million acres of wetlands were delineated. The total only includes wetland areas greater than 40 acres, wetland/upland complexes, and playas. Table 3-10 shows the areas covered by different types of wetlands greater than 40 acres separated by type. The amount of vegetated wetlands by type is shown in Table 3-11.

Table 3-10. Wetlands Greater than 40 Acres by Wetland Type	Acres
Playas	935,500
Vegetated wetlands, ponds, misc. types	665,400
Wetland/upland complexes	100,800
Total	**1,701,700**
Source: U.S. Fish and Wildlife Service, Nevada Office	

Table 3-11. Wetlands Greater than 40 Acres by Vegetation Type	Acres
Emergent wetlands	501,700
Scrub/shrub wetlands	160,800
Unvegetated wetlands and ponds	3,500
Total	**666,000**
Source: U.S. Fish and Wildlife Service, Nevada Office	

In addition, the mapping identified 30,547 wetlands less than 10 acres in size; 1,370 wetlands between 10 and 40 acres in size; and 29,810 miles of linear wetlands. Acreages are not estimated for these. The surface area of lakes and reservoirs was estimated to be 364,800 acres of lakes and reservoirs, in addition to the 1.7 million acres of wetlands (U.S. Fish and Wildlife, 2001b). Open water and wetlands cover about 0.5 percent and 2.3 percent of the state, illustrating how limited are aquatic habitats. Wetland size data separated by county is shown in Table 3-12.

Protection and rehabilitation of wetlands is challenging because of the competition for land and water resources required for increasing urban, agricultural, and transportation system developments. Projects by NDOW, NDSL, and federal agencies to purchase water rights for premier wetland areas provide for long-term stabilization of core wetland habitats. In some cases, however, sufficient water may not be available during drought conditions. Most significant wetland areas in Nevada are located within state wildlife management areas, federal wildlife refuges, tribal lands, and other specially designated management units. The NDOW has acquired or leased large tracts of land to establish 12 wildlife management areas (WMA's), 10 of which contain 59,250 acres of wetlands and open waters. A wetland conservation plan will be developed for each by the Division with public input.

A variety of wetland conservation and improvement projects are underway throughout the state. For example, in Oasis Valley, The Nature Conservancy has purchased a perpetual easement for riparian wetlands through the Wetlands Reserve Program, which is administered by the U.S. Natural Resources Conservation Service. The site is on a ranch near Beatty. Riparian habitat will be restored or enhanced on 190 acres to benefit two special status species, the Amargosa toad and the Oasis Valley speckled dace, and other wildlife and wetland species.

Another project is centered on the Las Vegas Wash. The site of 2,000 wetland acres in the 1970's, the wash became seriously eroded when runoff from urban development and discharges from wastewater treatment plants increased. The wetland area was reduced to 400 acres. Citizen organizations, local utilities, and government agencies are cooperating in the implementation of a comprehensive plan that concentrates on erosion control, environmental monitoring, and wetland construction. Primary benefits include improvement of water quality entering Lake Mead, outdoor recreation opportunities for Las Vegas Valley residents and visitors, and more diverse, healthier habitats for Mojave Desert wildlife.

The FWS is leading a multi-party effort to recover a portion of the wetlands in the Lahontan Valley wetlands complex in western Nevada. This area is a critical stopover for migrating shorebirds and one of 14 Western Hemispheric Shorebird Reserve Network sites. When sufficient water is available, up to 70 percent of Nevada's migratory waterfowl population use the wetlands. More than 175,000 waterfowl regularly stop in the valley during migration, and peak counts of up to 475,000 birds have been recorded. Historically, the Carson River sustained an average of about 150,000 acres of wetlands in the Lahontan Valley.

Table 3-12. NWI Reconnaissance Level Mapping Units By County							
County	Number of Wetlands <10 Acres	Number of Wetlands 10-40 Acres	Acres of Wetlands > 40 acres[1]	Acres of Wetland/ Upland Complexes[1]	Miles of Linear Wetlands[2]	Acres of Playas[1]	Acres of Lakes and Reservoirs[1]
Carson City	38	----	350	----	50	----	6,950
Churchill	1,310	64	27,150	34,900	750	181,050	23,400
Clark	353	16	11,500	----	2,170	23,700	97,800
Douglas	305	23	27,950	900	350	----	17,250
Elko	11,189	367	181,900	1,050	8,790	25,900	9,550
Esmeralda	326	15	5,700	1,800	180	38,300	1,450
Eureka	1,610	65	37,700	6,000	1,560	48,250	----
Humboldt	3,406	116	134,350	950	3,380	28,900	4,050
Lander	1,392	68	79,400	3,550	1,490	35,900	50
Lincoln	644	35	11,650	2,800	1,240	71,700	1,150
Lyon	764	115	16,950	11,300	840	7,150	8,800
Mineral	668	25	9,750	150	1,160	23,500	36,600
Nye	2,625	145	30,800	15,900	2,750	114,350	1,700
Pershing	912	53	19,450	1,750	1,650	146,650	16,300
Storey	35	1	100	----	40	----	----
Washoe	2,678	162	22,200	800	1,800	152,450	139,150
White Pine	2,292	100	49,200	18,950	1,600	37,700	650
State Total	30,547	1,370	666,100	100,800	29,800	935,500	364,850

Source: U.S Fish and Wildlife Service, Nevada Office.
Notes: [1] To the nearest 50 acres. [2] To the nearest 10 miles.

Competing demands for water reduced the wetland acreage more than 90 percent, to less than 10,000 acres. By 1992, several years of drought caused the wetland acreage to drop below 2,000 acres. Meanwhile, Congress in 1990 passed the Truckee-Carson-Pyramid Lake Water Rights Settlement Act. The legislation established a program to acquire from willing sellers water and water rights sufficient to maintain a long-term average of about 25,000 acres of wetland habitat on the Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake, and the Fallon Paiute-Shoshone Indian Reservation.

Riparian Zones

Riparian zones hold particular importance for many Nevadans. The diversity of fish and wildlife, the quality and quantity of water resources, and a wide variety of outdoor recreation resources are strongly connected to presence and quality of riparian ecosystems. Riparian ecosystems occur in the full range of climate zones and landforms. Consequently, there are many varieties of riparian communities. Some are dominated by short or tall grass and grass-like species, by willows and other shrubs, by cottonwood, aspen and other trees, or by varying mixtures of trees, shrubs, grasses, and forbs. Healthy riparian zones play a vital role in commercial uses of rangeland ecosystems, for example, by providing abundant forage and shade for livestock. Recognizing the downward trend in conditions due to over-utilization of streamside vegetation and embankment erosion, the BLM and USFS launched a major initiative in the early 1990's to improve riparian management and protection.

The BLM and the USFS monitor riparian areas on lands under their management. Using an assessment method called "proper functioning condition," (PFC) the BLM has performed site evaluations on 99 percent of the riparian areas and 33 percent of wetland meadow areas. In the PFC method, the hydrology, vegetation, channel erosion, sediment deposition, and land use features are evaluated to determine the overall physical condition in terms of the potential natural plant community and important resource values. Of 2,537 miles of riparian habitat mapped on BLM land, 753 were classified as "proper functioning condition" and 489 as "non-functional." Of the remainder, 495 miles were trending toward the desired condition, 321 miles trended downward, and the trend was not apparent in 475 miles. Wetland acres were also assessed. Of 34,327 acres, 8,962 were considered to be properly functioning, 476 acres trending up, 382 trending down, and on 1,400 the trend was not apparent. About 170 acres were classified as non-functional.

The USFS has conducted extensive monitoring in the western and central mountains of Nevada as part of the preparation of ecological "scorecards" for riparian condition assessments. Though the data has not been centrally organized, general conclusions can be drawn based on scorecard development at almost 1000 sites. Steeper and higher elevation stream reaches tend to be more stable and well vegetated. Streams and meadows at lower elevations tend to be in unacceptable condition. However, trend in condition on USFS land is generally upward for a majority of all stream reaches. These generalizations include riparian sites in both forest and rangeland areas.

Restoration of degraded riparian habitat is a primary objective in the Recovery Plan for the Lahontan Cutthroat Trout, prepared by the FWS in 1995. Because Lahontan cutthroat trout formerly inhabited northern Nevada lakes, rivers and headwater streams, restoration of degraded riparian habitat will be a regional effort involving many agencies, conservation organizations, ranch owners, and more. Extensive riparian zone restoration efforts on the Marys River and Trout Creek in northern Nevada have already occurred.

Springs

The wetland habitats identified in Table 3-12 as being less than 10 acres and between 10 and 40 acres (second and third columns) include a distinctive subset of riparian and aquatic habitats commonly called a spring. A spring occurs where deep or shallow groundwater flows naturally from bedrock or natural fill onto the land surface and forms a body of water. The source and subterranean pathway of water may be local or regional. Thousands of springs occur in a variety of landform settings throughout the state. Springs were important to emigrants crossing Nevada. Many have been developed to provide water for livestock, mining, wildlife, and public and domestic water supply. Gains in scientific knowledge about the relevance of spring habitats to biodiversity and the longevity of "ancient" water supply sources has drawn attention to spring conservation and management. Because springs are isolated and have unique environmental characteristics, aquatic and riparian plant, fish, and invertebrate (e.g., springsnail) diversity and endemism are high.

Chimney Hot Springs in Nye County is a refuge for Railroad Valley springfish (Crenichthys nevadae). The Railroad Valley springfish was placed on the federal list of threatened species in 1986 due to habitat degradation related to water diversions, overgrazing, and exotic fish introductions. A majority of the 23 endangered or threatened fish species in Nevada survive only in unique spring habitats. Spring photo by Glenn Clemmer, 1989. Springfish photo by Peter Unmack, 1994.

Like other water-associated habitats, dewatering, diversion works,

channelization, and invasion of nonnative plants and animals have altered springs (U.S. Bureau of Land Management, 2001). Groundwater pumping has been found in some basins to depress spring flow. Field studies have found degraded habitat conditions, declines in sensitive plants and animal populations, and species extinctions. Similar to other wetlands, springs are intensively used. Livestock, including wild horses, and diversions, many for livestock watering, were the predominant disturbances found in one study of 511 northern Nevada springs (Sada, 1991). Concern exists that current protection and management attention is not sufficient to sustain the ecological site integrity and long-term water production of springs.

Non-Native Flora and Fauna

Whether introduced for a specific purpose or accidentally, an increasing number of non-native species are devastating native habitats and croplands. The spread of noxious and invasive weeds and insects adds significant costs to the use and management of natural resources throughout the state. Non-native plants and animals, if not kept in check, have the ability to spread rapidly, resist controls, exclude native species, interfere with crop and forage production, degrade wildlife habitats, promote wildfire, leave soils vulnerable to erosion, and alter entire ecosystems.

Non-Native Flora

With increased globalization and human mobility Nevada's ecosystems are at greater risk of exposure to undesirable plants. The growing number of state-designated noxious weed species illustrates the threat posed by invasive plant species or weeds in Nevada. In 1992, there were 29 weed species officially designated by the Nevada Department of Agriculture (NDOA) as noxious (Table 3-11). By 2001, 13 additional non-native species were classified as noxious. In 2002, two more plants will be added to the noxious weed list – Fountain grass (Pennisetum setaceum) and Giant salvinia (Salvinia molesta) – raising the total to 46 noxious weeds in the state (Nevada Department of Agriculture, 2002).

Nevada, like most states, has a law for designating certain weeds as "noxious." Nonnative plant species designated as noxious are characterized as prolific, and are difficult to control or eradicate. They displace desirable plants on agricultural lands and natural sites, and causes significant environmental and/or economic damage. "Invasive weed" is a separate, unofficial, category of damaging alien plants. The key distinction is that noxious weeds are considered to be manageable and may be eliminated. An invasive weed species has become so widespread that eradication is infeasible. State law requires landowners to control noxious weeds that occur on their property (NRS 555.130). Unfortunately, resources to prevent or limit the spread of nonnative plants are limited, so public and private land managers must decide whether to control the plants that already are dominating plant diversity, or those that may become dominant in the future if not immediately controlled.

Noxious weeds have impacted several land cover types. Floodplains and riparian zones have been smothered with perennial pepperweed and whitetop. Tamarisk obstructs stream channels. Croplands are infested by Russian knapweed and yellow star thistle. Musk thistle and diffuse knapweed choke out native plants from pastures and other ranchlands. Shrublands, pasture, cropland, and riparian zones appear to be the most heavily impacted cover types.

The serious economic and ecological damage caused by noxious and invasive weeds makes preventing new introductions a top priority for state and federal agencies. To coordinate early control efforts, Conservation Districts (CDs), federal and state land use management agencies, scientists, ranchers, and farmers and others are assisting with mapping the occurrence of noxious weeds. Preliminary mapping and reporting of the extent of noxious weed infestations has produced a rough estimate of 276,000 acres (Table 3-13). However, this number underestimates (perhaps grossly) the statewide impact. Field mapping is incomplete, and some landowners have not inventoried or reported data on infestations yet.

Cheatgrass (*Bromus tectorum*) is the most widespread "invasive" plant in Nevada. Cheatgrass and its southern cousin, red brome, exemplify the vulnerability of the state's rangelands. Cheatgrass has invaded sagebrush zones in numerous basins. Scientists have observed the plant invading mountain shrub zones, indicating it may be adapting to other climate zones. Following repeated wildfires, cheat grass forms a monoculture. During the growing season, livestock, wild horses, and other grazers can eat and gain nutritional value from cheat grass. However, after cheatgrass cures in early to late spring, the nutritional value and edibility of the plants declines. Domestic and wild grazing animals, upland birds, and other wildlife must go elsewhere to meet their nutritional and other habitat needs. According to the report *Nevada's Coordinated Invasive Weed Strategy* prepared by the Nevada Weed Action Committee, approximately nine million acres in northern Nevada (about 13 percent of the total state) has succumbed to the cheatgrass invasion.

Table 3-13. Reported Acres Infested by Noxious Weeds for Various Government Jurisdictions

Organization	Area within Jurisdiction	*Reported Area of Infestation
	Acres	
Douglas Weed Dist.	144,769	15,000
Churchill Weed Dist.	640,000	6,400
Division of Wildlife	142,959	17,955
Division of State Parks	132,878	1,000
Department of Transportation	133,000	12,000
University Lands	25,000	unknown
Tribal Lands	1,218,651	12,000
Conservation Districts	11,000,000	unknown
Bureau of Land Management	46,500,000	195,750
US Forest Service	6,500,000	16,000
US Fish & Wildlife	2,218,000	unknown
Total		276,105

Source: Nevada Department of Agriculture,2001.
Note: *The area of Weed Districts may overlap Conservation Districts, resulting in double counting.

Much is being done to combat the introduction and spread of noxious weeds. Nevada's 28 Conservation Districts, which cover the entire state, have traditionally focused much of their resources on the control of invasive weeds located within the district. In addition, with the increased awareness of the threats posed by invasive species, the formation of weed control districts in Nevada has increased from six in 1992 to 10 in 2000. Conservation Districts and weed control districts typically consult and work closely with experts at their local University of Nevada Cooperative Extension and the Natural Resources Conservation Service offices.

Increased awareness in large part is due to efforts of the NDOA. In 1995, the NDOA created an interagency working group whose mission was to coordinate and facilitate local, county, state and federal agency programs and projects for the control and management of noxious and invasive weeds in Nevada. The group was named the Nevada Weed Action Committee (NWAC). A result of the formation of this group is the creation of the state weed plan, *The Nevada Coordinated Invasive WeedStrategy*. The strategic plan emphasizes five key objectives: weed control; prevention of new infestations; education and awareness; cooperative and coordination of control efforts; and, research.

The NWAC has taken on the challenge of effectively coordinating public and private resources and efforts toward proactive prevention, control, and management of invasive weed species in Nevada to benefit all land users in the state. The NWAC emphasizes prevention of additional invasions and quick action to eradicate new introductions, primarily because these are the most cost effective approaches. An example is the program to inspect for and certify hay and forage as "weed free." Another priority is mapping the occurrences of noxious and invasive weed species on a real-time basis to ascertain the level of threat, update management priorities, and assist with coordinated weed management plans. Other NWAC priorities include improved communication and education, and finding project funding (Nevada Weed Action Committee, 2002).

Non-Native Fauna

Invasive invertebrate species continue to be introduced into Nevada at an alarming rate. In recent years both the Turkestan cockroach and the Africanized honeybee have expanded to fill niches in southern Nevada. In 1999 and 2000, nine sites infested with red imported fire ants were eradicated in Clark County. Surveys for gypsy moth and Japanese beetle have both been negative in recent years. Surveys and inspection efforts for these and other threatening species have been increased (Nevada Department of Agriculture, personal communication, 2001). All survey, detection, monitoring and control activities relating to invasive invertebrate species are closely coordinated between the Nevada Department of Agriculture and the USDA Animal and Plant Health Inspection Service.

Control of Plant and Animal Infestations

In general, the choices for methods to control or eliminate noxious weeds are mechanical, biological, and chemical. Each has its advantages and disadvantages, depending upon the species, site conditions, and type of land use. The use of herbicides, insecticides, and fungicides (i.e., pesticides) to control noxious weeds and other pests requires special care and oversight because contamination of soil and water can pose serious health threats to people and other life forms. Even with proper use, some chemicals that are mobile, persistent, or degrade into other toxic chemical compounds may accumulate in surface and groundwater bodies. Using pesticides at higher rates or in a place or manner of use different from label specifications is against the law.

State laws give the NDOA authority to manage pesticide use and coordinate with other organizations in monitoring use and effects. The agency trains and certifies pesticide applicators, investigates complaints concerning pesticide use, and monitors the use of pesticides. The Nevada Agricultural Statistics Service compiles data contained in mandatory monthly reports submitted by custom applicator licensees to NDOA. Licensed applicators in 2000 reported that approximately 133,140 acres of farm and ranch land were treated with one or more types of pesticide. This is not a complete summary in that it does not include chemical applications by individual farmers and ranchers who may apply chemicals on their own operations (Nevada Agricultural Statistics Service, 2002).

The NDOA, USGS, and NDEP periodically monitor groundwater quality in areas where pesticides are used. The presence of pesticides has been detected in the groundwater around urban and agricultural areas, but at levels below drinking water maximum contaminant levels. Local University of Nevada Cooperative Extension offices have experts in the area of noxious weed and insect pest controls and can provide state of the art information on the responsible use of pesticides.

Wild Horses and Burros

Wild Horse and Burro Populations

The federal Wild and Free-Roaming Horse and Burro Act of 1971 requires the BLM and USFS to protect, manage, and control wild free-roaming horses and burros on public lands at population levels that assure a “thriving natural ecological balance” under the multiple use concept. The Act defines ecological balance as the balance on a long-term sustained yield basis between populations of wild horses, burros and wildlife, livestock, and rangeland vegetation. The federal agencies manage wild horses and burros at the minimum feasible level to treat the animals as wildland species and not as livestock. Management focuses on monitoring, removal of excess animals, preparing them for adoption, the adoption process, and compliance after adoption for one year when title is given.

Wild horses and burros are found throughout the western states, but nowhere do their populations come close to those in Nevada. The first aerial count, conducted in 1974, found approximately 20,000 animals. In 2000, the BLM estimated a total of 48,624 wild horses and burros roamed BLM land in the 10 western states, of which 25,096 (52 percent) inhabited Nevada (Table 3-14). In 1996, the USFS estimated that

746 wild horses occupied Humboldt-Toiyabe National Forest land within Nevada. Most of the wild horses and burros in Nevada live on open rangeland managed by the BLM. Though the large number of animals has brought national and even international attention from wild horse enthusiasts, the vegetation and water resources in areas overpopulated by wild horses have been seriously impacted.

Federal agencies initially identified wild horse Herd Areas based on animal distributions at the time federal legislation was passed. Within Herd Areas, the BLM has delineated 103 Herd Management Areas (HMA's) and the USFS delineated 13 Horse Territories. These wild horse areas are distributed throughout the state. The HMA's managed for wild horses are located primarily in the Great Basin ecoregion. In the Mojave region, the habitat is better suited to burros. The HMA's vary in size from as small as 5,000 acres to almost 700,000 acres, with most exceeding 100,000 acres. Land designated as HMA's also contains livestock grazing allotments and populations of wildlife species.

Table 3-14. Wild Horse and Burro Populations and Amounts Removed, 1980 - 2000

Year	Population*	Removals*
1980	32,199	---
1981	---	---
1982	27,380	---
1983	---	---
1984	31,386	1,410
1985	30,569	10,440
1986	28,872	5,444
1987	28,533	6,825
1988	28,401	4,294
1989	32,067	1,332
1990	29,455	3,023
1991	33,434	4,168
1992	34,677	3,632
1993	26,664	5,103
1994	23,107	5,328
1995	24,067	6,701
1996	23,483	5,884
1997	22,865	6,295
1998	22,463	4,581
1999	23,905	2,500
2000	25,096	4,131
2001	22,100	---
Total Removals		81,406

Source: Nevada BLM, 2001.
Note: *Includes only lands managed by Nevada BLM, not those managed by California BLM in northwestern Nevada.

Wild Horse and Burro Management

Because forage production on Nevada rangelands is limited and must be shared among wildlife, livestock, and wild horses, public rangeland managers are required to set the Appropriate Management Level (AML) for wild horses and burros on each HMA. The number of wild horses, or AML, is set through a rangeland assessment and public review process known as the Allotment Evaluation/Multiple Use Decision. The AML is the number of wild horses that can inhabit a herd management area while maintaining a thriving natural ecological balance and avoiding deterioration of the rangeland and riparian resources.

As of September 2000, the AML had been achieved on thirty-eight (38) of the BLM managed HMA's. During the winter, additional gathers increased the number of HMA's achieving the AML by five. Four more HMA's are scheduled for gathers in the summer of 2001. As with many wild animal populations, the number of wild horses increases each year at a rate that is determined by the amount of seasonal precipitation and vegetative growth. Achieving and maintaining AML within herd management areas requires periodic removal of horses. From 1980 to 2000, the BLM removed over 81,400 wild horses (Table 3-13). The status of wild horse management on HTNF herd territories in Nevada is not available.

Recent fires and drought in the Great Basin have impacted wild horse habitat conditions. During the summer of 1999, wild fires burned approximately 1.6 million acres of land administered by the BLM. Twelve HMA's were burned, with the losses extreme enough in seven HMA's to require removals of all or a portion of the herds. In total, 2,070 animals were removed as a result of habitat losses from the fires. About 340 wild horses were being held for reintroduction into the burned HMA's from where they were gathered. The following winter of 1999/2000 was extremely dry and a number of HMA's were impacted by inadequate water supplies, forage or both. As a result, 1,980 wild horses and burros were removed in the summer of 2000 from 14 HMA's. The removals were targeted toward those herds severely impacted by the drought conditions. Only a few HMA's were reduced to the AML. With the emphasis on

emergency gathers due to habitat damaged by fires and drought, most of the planned gathers scheduled for FY 2000 were postponed. Less than 100 animals were removed from scheduled gathers.

Wild horses roam throughout the open range in southern Nevada. Careful population management is necessary in some areas where reproduction is high and resources are sensitive to excessive grazing and trampling, such as riparian zones. Protection of wild horse herds attracts national, even international attention. Photo courtesy of the Nevada Commission for the Preservation of Wild Horses.

BLM is charged with managing the public land for multiple uses. With the passage of the Wild and Free Roaming Horse and Burro Act in 1971, which came about because of nationwide concerns, BLM was mandated to manage those resources along with the multitude of other legitimate land uses. The competition for forage, of course, creates the greatest conflict. The act states that horses and burros must be managed within a "thriving ecological balance." BLM has interpreted that to mean that the forage use by all grazing animals must be within the carrying capacity of the land.

BLM rangeland grazing standards and guidelines have been established for four regions in the state by Resource Advisory Councils in each region. The standards describe regional soil, vegetation, water, wildlife habitat conditions, with the resource use and management guidelines, that are necessary to sustain the carrying capacity and ecological functions of rangeland resources consistent with community needs in the region. Maintaining wild horse populations at AML is important if the Rangeland Standards are to be met and the land managed at a "thriving ecological balance." Continued overstocking of the public lands by any one or a combination of grazing animals, domestic or wild, can create long-term degradation of rangeland resources and ultimately destroy the productivity of the land.

The adoption program is the only available option to care for animals removed from the range. The adoption market is very fragile and numerous forces affect that market, including publicity on the Wild Horse and Burro program. The adoption market also affects range management because if adoption targets are not met, BLM preparation and holding facilities quickly reach capacity. When the facilities become full, gathers must be slowed or ceased. Altering the gather schedule has a domino effect on achieving AML on HMAs scheduled for gathering that year, gathers in subsequent years. Several ranchers in the Midwest are under contract to hold wild horses, especially older, unadoptable animals, on a long-term basis to relieve the lack of holding space in BLM facilities.

A promising approach to improving the adoptability of wild horses is being implemented by the Nevada Department of Agriculture and Prisons. Recently, a wild horse inventory and habitat evaluation showed that 1000 wild horses were living in the Virginia Range of western Nevada where the habitat was suitable for only 500 individuals. In the Virginia Range Estray Program, wild horses are taken to the Western Nevada Correctional Center and gentled for six weeks before nonprofit "placement" agencies sell them to qualifying private owners.

Wildland Fire

Nevada, like many western states, is facing the escalation of wildland fire impacts in both rural and urban areas. From 1999 to 2001, almost 3,800 fires burned approximately 3.25 million acres, most in the northern half of the state (Table 3-15). The tremendous damage to biological resources and environmental quality caused by the extraordinary wildfire behavior cannot be adequately quantified or described. The distribution of Nevada wildfires from 1981 through 2000 (aggregated in five year

increments) is displayed in Figure 3-8. (Note that a number of areas have re-burned, although the overlapping patterns may be difficult to discern on the map.)

Table 3-15. Wildland Fire Season Statistics on Federal and Non-Federal Land, 1999-2001

Year	Number of Fires		Number of Acres Burned		Number of Fires by Cause			
	Federal Land	Non-Federal Land	Federal Land	Non-Federal Land	Federal Land		Non-Federal Land	
					Lightning	Human	Lightning	Human
1999	1,079	73	1,708,563	161,722	684	395	19	54
2000	1,067	104	692,553	6,657	820	247	63	41
2001	1,277	182	654,253	22,069	960	317	30	152
Total	3,423	359	3,055,369	190,448	1,504	642	112	247

Sources: Western Great Basin Coordination Center (WGBCC) website: www.nv.blm.gov/wgbcc. Western State Fire Managers reports, 2000 and 2001. Nevada Division of Forestry, 2002.
Notes: Values do not include prescribed fires or wildland fire use (controlled burn). The WGBCC reports for the three year period that 75 prescribed fires burned 42,300 acres. Wildland fire use data for 2001 is 45 fires and 9,211 acres burned. Prescribed fires are defined as those, which have been ignited by fire management personnel to meet specific resource management objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition. Wildland fire use describes the management of naturally ignited (lightning) wildland fires to accomplish specific pre-stated resource management objectives in predefined geographic areas outlined in Fire Management Plans.

The NDF cooperates with federal and local entities to mitigate threat of wildland fire statewide. Volunteer Fire Departments (VFD's) are a key player in wildfire suppression activities. VFD's typically are first on the scene of emergency incidents and provide critical information to arriving out-of-area state and federal fire suppression resources. The NDF provides training, equipment and vehicle maintenance support to VFD's within eight fire districts. The agency engages in initial attack, fire investigation, and direct protection capabilities to portions of the Humboldt-Toiyabe National Forest. NDF also partners with federal agencies, local government, and private property owners to locate funding for and implement rehabilitation projects on private land.

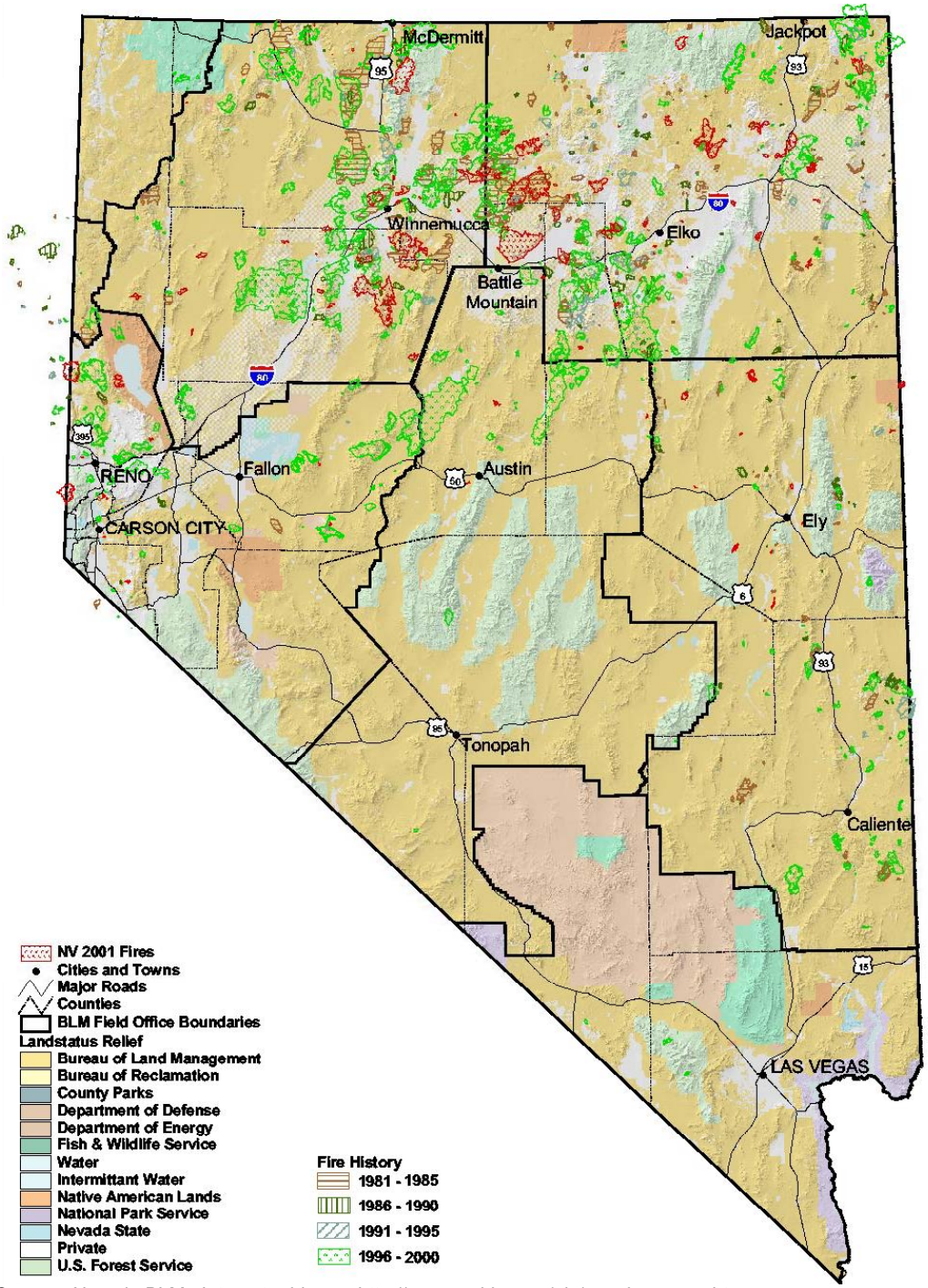
NDF and federal fire management agencies are increasing efforts to advise property owners on defensible space practices for the increasing number of homes built in the urban/wildland interface. The BLM and USFS fire suppression and prevention programs also are instrumental in protecting the state's natural and cultural resources. Recognizing the critical need to share information, expertise, and resources, intergovernmental entities have been formed. These are the Western Great Basin Coordination Center and the Sierra Front Interagency Dispatch Center.

Especially troubling is the cumulative, long-term natural resource losses caused by the greater intensity and number of large wildland fires in recent years. At the end of August 1999 fire storms, the NDOW estimated habitat losses for some game species: 340,000 acres of deer winter range, 305,000 acres of deer summer range, 668,100 acres of pronghorn antelope range, and 45,500 acres of bighorn sheep range were seriously impacted. In addition, about 144,560 acres and 185,667 acres of winter/spring and summer sage grouse habitat burned (Nevada Division of Wildlife, 1999). In addition, the fires killed livestock and destroyed structures, such as homes, fences, water developments, bridges, ranch buildings, and power lines.

Fire, like flooding and drought, is a natural disturbance that periodically returns to play an influential role in ecological cycles of a variety of vegetation types, especially in the semi-arid climate zones, as illustrated in Figure 3-8. Historically, people have used fire to alter vegetation and grow certain plants for food, fiber and to attract game animals. Since the 1950's, wildland fires were uniformly excluded to prevent destruction of the commercial value and natural functions of forests and rangeland. Ironically, aggressive firefighting in the past 50 years is one reason that recent fire seasons are notable for excessively large and destructive burns. Aggressively suppressing fires allowed overcrowding of shrub

species less adapted to fire and accumulation of dead plant matter. However, the present day wildfire problems are more complicated than recent fire suppression policies. The current wildfire pattern is both a response to and cause of "impaired" ecological conditions in fire prone shrub, woodland, and forest types.

Figure 3-8. Distribution of Wildfires In Nevada, 1981 to 2000, Mapped by Nevada BLM



Source: Nevada BLM. Internet address: http://www.nv.blm.gov/gis/popular_maps.htm
Note: The database contains a majority of fires greater than 10 acres that occurred in Nevada.

Though fire exclusion efforts increase fuels, land use practices precondition rangelands and forests for extreme wildland fire. Forage and timber harvest practices that extensively modified the composition, structure, and diversity of fire-adapted plant communities contributed to the conditions that are conducive to extreme wildland fire behavior. Widespread over-grazing and clear-cutting helped set the stage. Little attention was paid to changes in the regeneration of sagebrush-steppe, sagebrush, woodland and forest communities. The density of plants in regenerating shrublands and forests increased as perennial grasses and forbs were persistently removed and lighter-fueled fires limited. Cheatgrass, a flammable nonnative annual grass, invaded the understory of shrub and pinyon/juniper communities, eventually forming monocultures as fires returned to infested areas. Riparian zones that were eroded, dewatered, and denuded no longer provided cooler and moisture conditions that provides a natural brake on the spread of wildfire.

Of special concern is the construction of more buildings in the urban-wildland interface where coincident with hazardous levels of woody fuels. With more subdivisions built in fire-prone and fuel-rich wildland areas, the risk of catastrophic natural resource and private property damage escalates. State, federal and local fire suppression agencies are committed to protecting life and private property. Fires burning at the urban/wildland interface require that more fire fighting resources be directed to save people and homes as a priority over natural vegetation. The result can be unnecessarily extensive damage to critical wildlife habitat, watersheds and water supplies, cultural resources, and outdoor recreation resources.

Expanding development in wildland areas also limit fuels management options, in some cases precluding tree harvesting or prescribed fires. Because most property owners have been reluctant to prepare defensible, fire safe, space around buildings, the NDF, BLM and other land management agencies are implementing technical assistance programs to promote defensible space practices. However, casual attitudes toward fire risk and inadequate local regulations for defensible space in new and existing subdivisions continues to hamper state and federal agency efforts to advance reasonable strategies for the protection of lives and property at the wildlife/urban interface.

The extreme fire events of recent seasons have focus attention on reduction of hazardous fuel conditions, restoration, and fire ecology in shrub, woodlands, and forests. Scientists are studying the pre-settlement role of fire in Nevada vegetation types and learning about the effects different land uses and management practices have had on vegetation patterns and wildfire behavior. Past fire rehabilitation efforts have not been extensively monitored, so practical knowledge is limited on revegetation prescriptions for the subtly different rangeland ecosystems. Gaps in knowledge, different interpretations of the meaning of restoration, and variation in visions of the future uses of fire-damaged lands raise important issues. Ongoing debates involve the use of native versus introduced species; on the use of prescribed burns versus mechanical removal of fuels; and the distribution of funding between suppression and prevention activities. Unfortunately, disagreements over wildfire science can delay development and implementation of much-needed, landscape-scale restoration, vegetation management, and fire prevention strategies.

Progress is being made in state and national efforts to improve fire management and restore burned areas. One example is the Great Basin Restoration Initiative (GBRI), proposed by the Nevada BLM during the catastrophic 1999 fire season. The active component of the GBRI, the Eastern Nevada Landscape Restoration Project, entails a 10 million acre area with diverse shrub, woodland, forest, and riparian habitats. A coalition of all interests has formed under the mission of improving the dynamic and diverse landscapes of the Great Basin for present and future generations through collaborative efforts. Restoration, defined as a long-term, landscape-based approach to changing ecological health, is emphasized rather than reclamation. Urban interface fuel reduction, cheatgrass/weed control, prescribed fire and natural wildfire use, and learning about the ecosystems are short-term tasks (Nevada Bureau of Land Management, 2002).

The 2001 National Fire Plan promotes and supports federal, state, and local fire fighting agencies on five fronts to interrupt the fire cycle. Priorities are: 1) reduction of fuels in dense shrub and pygmy conifer zones; 2) restoration of burned areas; 3) protection of healthy native communities and restoration of degraded communities to reduce extreme wildfire risk; 4) enhanced fire suppression; and, 5) advance fire management planning that take into consideration local public safety, ecological site conditions,

biodiversity concerns, and cultural resources (National Interagency Fire Center, 2002). The Nevada Division of Forestry has the lead in developing a complementary State Fire Plan that will build on priorities set by the Governor's Wildfire Management Committee in 2000. Priorities include interagency risk/hazard assessment mapping; education and training of local volunteers, miners, and ranchers; fuels management emphasizing livestock grazing and green stripping; fire-safe community legislation; and, expansion of the state native seed bank.

References

Bradley, P.V., J.A. Williams, J.S. Altenbach, P.E. Brown, K. Dewberry, D.B. Hall, J. Jeffers, B. Lund, J.E. Newmark, M.J. O'Farrell, M. Rahn, and C.R. Tomlinson. 2002. Nevada Bat Conservation Plan. Nevada Bat Working Group. Austin, Nevada.

Charlet, David A., 1998. *Atlas of Nevada Mountain Ranges; Vegetation Zones of Nevada*. Biological Resources Research Center, University of Nevada, Reno and Department of Science, Community College of Southern Nevada, North Las Vegas.

Dahl, T.E. 1990. *Wetlands Losses in the United States, 1780's to 1980's*. U.S. Department of the Interior, Fish and Wildlife Service. Washington D.C.

Fiero, B. 1986. *Geology of the Great Basin*. Max C. Fleischmann series in Great Basin Natural History. University of Nevada Press, Reno, Nevada.

Grayson, D. K. 1993. *The Desert's Past: A Natural Prehistory of the Great Basin*. Smithsonian Institution Press, Washington, D.C.

Hutchins, Mary. 1999. Prairie Racer: the Pronghorn Antelope. North American Pronghorn Foundation Web Page. Internet Address: http://www.antelope.org/pronghorn1.htm

National Interagency Fire Center. 2002. National Fire Plan, Managing the Impact of Fires on the Communities and the Environment. Internet address: http://www.fireplan.gov/president.cfm

NatureServe. 2002. *States of the Union: Ranking America's Biodiversity*. Prepared for The Nature Conservancy. Arlington, Virginia.

Nevada Agricultural Statistical Service. 2002. Pesticide And Herbicide Application Summary, 2000. Internet address: http://www.nass.usda.gov/nv/Pesticide01.pdf

Nevada Bureau of Land Management. 2002. Eastern Nevada Landscape Restoration Project. Internet address: http://www.nv.blm.gov/ely/enlrp.htm

Nevada Department of Agriculture. 2002. Personal communication.

Nevada Division of Wildlife. 1999. Wildfire, An Assessment of Wildlife Losses Resulting from the 1999 Firestorm.

Nevada Division of Wildlife. 2001. *Nevada Sage Grouse Conservation Plan, Final Draft*. Prepared by Governor's Sage Grouse Conservation Team.

Nevada Natural Heritage Program. 2000. *Scorecard 2000, Highest Priority Conservation Sites*.

Nevada Natural Heritage Program. 2001a. Personal communication.

Nevada Natural Heritage Program. 2002. Internet address: http://www.state.nv.us/nvnhp/datasens.htm

Nevada Partners in Flight. 1999. Bird Conservation Plan. Larry Neel, ed.

Nevada Weed Action Committee. 2002. Internet address: http://agri.state.nv.us/nwac/

Sada, D.W., G.L. Vinyard, and R. Herschler. 1991. *Environmental Characteristics of SmallSprings in Northern Nevada*. In Proceedings of the Desert Fishes Council. Volume XXIII.

Strickland, Rose. 2002. Personal communication. Comments on the Public Review Draft, Nevada Natural Resources Plan.

The Nature Conservancy. 2000. *Precious Heritage: The Status of Biodiversity in the United States*. Edited By Bruce A. Stein, Lynn S. Kutner, and Jonathan S. Adams. Oxford University Press.

Thompson, S.P., and K.L. Merritt. 1988. *Western Nevada Wetlands – History and Current Status*, in Blesse, R.E. and P Goin, eds., Nevada Public Affairs Review No. 1. Reno, University of Nevada.

U.S. Army Corps of Engineers. 2001. Personal communication. Table of Impacted Wetland Acreage (Non-Tidal).

U.S. Bureau of Land Management. 2001. *A Guide to Managing, Restoring, and Conserving Springs in the Western United States*. Technical Reference 1737-17. National Science and Technology Center, Denver, Colorado.

U.S. Department of Agriculture. 2002. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Internet address: http://www.fs.fed.us/database/feis/index.html

U.S. Fish and Wildlife Service, Nevada Office. 2001a. Review comments submitted to DCNR pertaining to the Draft Nevada Natural Resources Report.

U.S. Fish and Wildlife Service, Nevada Office. 2001b. Personal communication. National Wetlands Inventory Mapping in Nevada, excerpted from draft report on the 1980's National Wetlands Inventory reconnaissance level mapping data.

Utah State University. 1997. Nevada Vegetation Cover-Type Codes and Descriptions (accompanies the Nevada Gap Land Use/Land Cover Map). Department of Geography and Earth Resources. Logan, Utah.